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

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Executive Summary

Wild rice is an annual, cross-pollinated plant that grows in flooded soils. Plants normally reach five to six feet in height and produce multiple tillers, or stems. The stems are hollow, except at the nodes where the leaves, roots, and flowers appear. The plant has a shallow root system with a lateral spread of 8 to 12 inches.

Wild rice seed is similar to the grain of cereals, such as wheat and oats. Immature seeds are green, but turn a purple-black color as they reach maturity. Seeds on any given stem mature at different times, and on the secondary stems, they mature later than on the main stems. Early-maturing seeds are very prone to shattering (dropping from the seed head) before the later-maturing seeds ripen.

Approximately 99 percent of the cultivated wild rice grown in the U.S. is produced in California and Minnesota. The remainder is produced in Idaho, Wisconsin, and Oregon. Minnesota’s cultivated wild rice is produced primarily on the north-central peatlands. California’s wild rice acreage is divided among three distinct climatic regions: the rice-producing areas in the Sacramento Valley; areas surrounding Clear Lake in Lake County; and the mountain valleys in northeastern California.

Wild rice farming in the Sacramento Valley differs markedly from wild rice farming in Minnesota. The most important differences are that Sacramento Valley farmers seed annually and have fewer disease problems than Minnesota producers. Although California's practice of annual reseeding is expensive, it prevents the yield declines which occur in Minnesota, where volunteer wild rice in succeeding years causes overcrowding of plant stands.

Although there are no official USDA estimates of Minnesota’s wild rice area, analysts familiar with the industry agree that the state has nearly twice as much acreage as California. The most commonly cited figure for 1995 is "about 17,000" acres. The California Wild Rice Advisory Board, on the other hand, reported 8,978 acres of wild rice in California in 1995.

The U.S. produces 10-12 million pounds (processed weight) of cultivated wild rice annually. Although Minnesota has the larger acreage, production is divided about equally between California and Minnesota. Growers in California obtain higher yields per acre and a higher percentage recovery of “finished” (processed) wild rice per pound of “green” (unprocessed) yield than growers in Minnesota. One source reported 5.3 million pounds of finished output for Minnesota in 1994, and 5.0 million pounds for California.

Wild rice is adapted to cool climates. It yields poorly in the southern United States, where extreme heat and shorter summer-time day lengths accelerate plant development and maturation, lessening seed production. In addition, the high humidity in the South favors the develop of leaf diseases, such as brown spot.

Virtually all wild rice is grown in flooded fields. The soil needs to be saturated from the time the seeds germinate in the spring until 2-3 weeks before harvest. The water depth during the first 8-10 weeks after germination needs to be held at a constant level to assure vigorous plant growth. Variable water depths during this period may uproot young plants or result in weak stems that lodge during water drawdown.

Wild rice may be either spring- or fall-planted in Minnesota. In California, seeding is done in the spring, except in some of the higher elevations, where planting may also occur in the fall. Annual reseeding in the spring is required in the Sacramento Valley because the paddies do not remain moist over the winter.

Production perils are generally of more concern in Minnesota than in California. Major causes of low wild rice yields include inadequate water with which to flood the paddies; uncontrolled flooding that washes out dikes and destroys young plants; wind storms which increase shattering and cause lodging; and hot, humid conditions which promote leaf diseases. Yield losses from most other perils usually do not reach an economic threshold.

Disaster assistance payments for wild rice losses totaled $3.2 million over the 1988-94 period. The largest payments were made in 1988, at $1.7 million. These large payments were due to drought, which prevented adequate flooding of the paddies, particularly in Minnesota. Across the 1988-94 period, Minnesota received 80 percent of the total payments, while California growers collected 14 percent.

There is likely to be substantial demand among wild rice growers for crop insurance, especially in Minnesota. This is because crop failures are frequent in that state due to adverse weather conditions. Drought, flooding, and wind storms all hold the potential for causing various degrees of crop failure in Minnesota. In addition, long periods of warm, wet weather can exacerbate yield losses due to leaf diseases.

There is likely to be less demand for wild rice crop insurance in California than in Minnesota. California growers are less likely to experience crop failures due to drought, and leaf

diseases have not been a source of major yield losses. In addition, flooding is less likely to cause production losses in California than in Minnesota.

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Introduction

Wild rice is a native North American cereal grain indigenous to lakes and slow-moving streams in the upper midwestern United States and southern Canada. It was a staple foodstuff in the diets of early North American inhabitants, and was one of the first items traded by the Indians to the French in the New World (Vennum).

Prior to 1965, most wild rice was produced in natural stands in lakes, rivers, and streams, where it was harvested using the traditional “canoe-and-flail” method. This method consisted of knocking the grain from its seed head into canoes or small boats, using light weight sticks or flails.

Natural wild rice is notorious for dropping early-maturing grain before later-maturing seeds on the same plant ripen (a problem known as "shattering"). Consequently, ripe grain was collected several times during the 10-14 day harvest in order to recover a larger portion of the potential crop. Natural-growing wild rice is called “lake rice,” and is still harvested in Wisconsin, Minnesota, and southern Canada.

Rather than focusing on natural wild rice, this report focuses on the feasibility of insuring cultivated wild rice, or "paddy wild rice," including the demand for insurance. Cultivated wild rice is grown in flooded, diked fields (or paddies), where it is seeded, fertilized, and managed as a cultivated crop.

History of Paddy Wild Rice Production

Farmers in Minnesota started producing cultivated wild rice during the 1950's and early 1960's, using seed from natural wild rice stands. Early attempts at mechanizing the harvest process were plagued, however, by low grain recovery due to shattering.[1]

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[1] Shattering is nature’s way of replanting before the seeds are eaten by predators. In addition to complicating growers' efforts to mechanize harvesting, shattering reseeds the paddies with seeds from the plants that are most prone to shattering. Consequently, over the years, plant populations tend to become increasingly shatter-prone.

Cultivated wild rice farming was given a boost during the 1960's with the development of shatter-resistant (or "non-shattering") varieties. Shatter resistance enables producers to delay harvesting until a higher proportion of the grain ripens, making once-over mechanized harvesting practical.

An additional boost to cultivated production came in 1965, when Uncle Ben's, Inc., began contracting for the production of wild rice. This development provided farmers with an expanded and dependable market for their output. Minnesota's wild rice acreage subsequently expanded, rising from 900 acres in 1968 to 18,000 acres in 1973 (Oelke and others, 1992).

California is the only additional state besides Minnesota which has substantial wild rice acreage, and began producing the crop commercially in 1977. Farmers in the Sacramento Valley already owned the paddies and equipment needed for growing white rice. Consequently, the switch to wild rice came easily in California, depending primarily on the price relationship between wild rice and white rice.

California's production rose from virtually zero in 1977 to 9 million pounds in 1986. Although output subsequently declined due to low prices, California produced an estimated 6.4 million pounds of processed wild rice in 1995, on nearly 9,000 acres (Tables 1 and 2).

The Wild Rice Plant

Although not a true rice, wild rice, like white rice, belongs to the grass family of plants. Wild rice belongs to the genus *Zizania*, while white rice belongs to the genus *Oryza*.

Of the four species of wild rice, *Z. Palustris* is the focus of this report. This species produces larger seeds than the other species and is the only one harvested as a food crop (Oelke, 1993).[2]

Wild rice is an annual, cross-pollinated plant that grows in flooded soils. Plants normally reach five to six feet in

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Inconsistency appears in the literature regarding whether the wild rice harvested for food is the species *Z. Palustris* L. or *Z. Aquatica* L. (Oelke, 1993; Steeves, 1952). The most recent literature, however, identifies the species used for food as *Z. Palustris* L.

height and produce multiple tillers, or stems. The stems are hollow, except at the nodes where the leaves, roots, and flowers appear. The plant has a shallow root system with a lateral spread of 8 to 12 inches (Oelke and others, 1992).

Wild rice seed is similar to the grain of cereals, such as wheat and oats. Immature seeds are green, but turn a purple-black color as they reach maturity. Seeds on any given stem mature at different times, and on the secondary stems, they mature later than on the main stems. Early-maturing seeds are very prone to shattering (dropping from the seed head) before the later-maturing seeds ripen.

Wild rice seeds do not germinate for at least three months after reaching maturity, even if environmental conditions are satisfactory for growth. An after-ripening dormant period in cold water (35^{o} or less) is required before the seed will germinate.

The grain has a high protein and carbohydrate content and is very low in fat. Its nutritional quality appears to equal or surpass that of other cereals.

Improved varieties of wild rice with shattering resistance have been developed for cultivated production. Nevertheless, all of the current cultivars shatter somewhat, and are also susceptible to lodging and diseases.

The most widely grown variety in Minnesota is 'K2,' which reaches a medium height. It is early to mature, and produces medium to high yields. Other improved varieties developed for Minnesota include 'M3,' 'Meter,' 'Netum,' and 'Voyager.'

'Johnson' is a widely-grown variety produced in California. The NorCal Seed Company has also developed a number of varieties that are widely grown in California (Williams; Oelke, 1993).

The Wild Rice Industry

Approximately 99 percent of the cultivated wild rice grown in the U.S. is produced in California and Minnesota. The remainder is produced in Idaho, Wisconsin, and Oregon.

Minnesota’s cultivated wild rice is produced primarily on the north-central peatlands. Production centers around the towns of Aitkin, Clearbrook, Grand Rapids, and Waskish, in north central Minnesota (Figure 1).

California’s wild rice acreage is divided among three distinct climatic regions: the rice-producing areas in the Sacramento Valley (Sutter County, and at various times, adjacent counties);

areas surrounding Clear Lake in Lake County; and the mountain valleys of Modoc and Shasta counties in northeastern California (Figure 2).

The climatic variations among these regions are indicated by their widely ranging altitudes. Marysville, in the Sacramento Valley, stands at 57 feet above sea level. Lakeport, in Lake County, is in the foothills at 1,345 feet, and Fall River Mills, in Shasta County, is in a mountain valley at 3,291 feet.

Wild rice farming in the Sacramento Valley differs markedly from wild rice farming in Minnesota. The most important differences are that Sacramento Valley farmers seed annually and have fewer disease problems than Minnesota producers (Winchell and Dahl).

Growers in the Sacramento Valley follow the practice of reseeding annually. Although annual reseeding is expensive, it prevents the yield declines which occur in Minnesota, where volunteer wild rice in succeeding years causes overcrowding of plant stands. Consequently, Sacramento Valley farmers are able to continually achieve first-year yields, which tend to exceed second- and third-year yields. An additional advantage of annual seeding is that growers can easily switch their paddies to improved varieties.

Canada is the only country other than the U.S. that produces significant quantities of wild rice.[3] Canada's production is limited almost entirely to wild rice grown on lakes. Much of Canada's lake wild rice is grown using a hybrid of the cultivated and lake production practices followed in the United States. Canadian producers may seed their lakes, but do not drain them prior to harvest, as is done with cultivated paddy production in the United States. Although the lakes remain flooded at harvest, harvesting has been mechanized with the use of air-boat harvesters.

The U.S. produces 10-12 million pounds (processed weight) of cultivated wild rice annually. Although Minnesota has the larger acreage, production is divided about equally between California and Minnesota. Growers in California obtain higher yields per acre and a higher percentage recovery of "finished" (processed) wild rice per pound of "green" (unprocessed) yield

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[3] One contact reported also seeing wild rice grown in southern Australia (Williams).

than growers in Minnesota.[4] One source reported 5.3 million pounds of

[4] Green wild rice usually yields about 40 percent finished product in Minnesota and about 50 percent in California (see the section on processing).

finished output for Minnesota in 1994, and 5.0 million pounds for California (Table 1).

Although there are no official USDA estimates of Minnesota's wild rice area, analysts familiar with the industry agree that the state has nearly twice as much acreage as California. The most commonly cited figure for 1995 is "about 17,000" acres (Nelson, 1996; Oelke, 1996). The California Wild Rice Advisory Board, on the other hand, reported 8,978 acres of wild rice in California in 1995 (Table 2).

In contrast to the industry's acreage and production estimates, the Census of Agriculture reported 90 farms producing wild rice on 34,437 acres in 1992, accounting for 23,209 million pounds of output (Appendix table 1). The discrepancies between industry and Census estimates of acreage and output may be due to differences in definition. The Census data may have included some lake rice in Minnesota, which would boost acreage above industry estimates. In addition, Census production appears to represent "green" (unprocessed) wild rice, while the industry estimates represent only the processed or finished product. The processed weight is typically 40 to 50 percent of the green weight.

The Census also includes information on minor producing states. According to the Census, Idaho harvested 95,000 pounds (finished weight) of wild rice from 665 acres in 1992. The majority of Idaho's output is located in Benewah and Kootenai counties in northern Idaho, where it is grown on lakes and diked areas along lakes and rivers. Although the fields are seeded, they remain flooded year round and are harvested with air-boat harvesters. Production reportedly varies substantially from year to year, due to unpredictable water levels and growing conditions (Henry).

In addition, there are about 200 acres of wild rice grown in western Oregon, by "fewer than a dozen growers" (Karow).[5] Yields reportedly average 800-1,000 pounds of green production per acre, translating into 100,000 pounds or less of processed output annually. The cultural practices used in Oregon are similar to those used by growers in northern California.

Farm Characteristics

Minnesota's wild rice farms tend to be operated as family-owned businesses (Winchell and Dahl). A 1983 survey of wild

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[5] This contact reported that most of the acreage was located in Benton, Linn, and Marion counties.

rice producers revealed that individuals or extended families operated

Table 1--Minnesota and California paddy wild rice production[1]

Year	Production		Year	Production	
	Minnesota	California		Minnesota	California
	--1,000 processed pounds--			--1,000 processed pounds--	
1968	36	0	1982	2,697	880
1969	160	0	1983	3,200	2,500
1970	364	0	1984	3,600	2,500
1971	608	0	1985	4,200	7,900
1972	1,496	0	1986	5,100	9,000
1973	1,200	0	1987	4,200	4,200
1974	1,036	0	1988	4,000	3,500
1975	1,233	0	1989	3,978	4,000
1976	1,809	0	1990	4,800	4,200
1977	1,031	0	1991	5,300	5,500
1978	1,761	100	1992	6,100	7,500
1979	2,155	200	1993	5,300	7,500
1980	2,320	400	1994	5,300	5,000
1981	2,274	500	1995[2]	4,300	6,440

[1] The 1968-1982 Minnesota values are from Winchell and Dahl and the 1983-1994 values are from the Minnesota Department of Agriculture. California values are from Marcum, Cooperative Extension Service, University of California.
[2] The value for 1995 is estimated.

Source: Extracted from University of Minnesota, 1996.

Table 2--California wild rice acreage and number of growers

Year	Acres	Growers
	----------Number----------	
1986	10,976	46
1987	7,554	51
1988	7,140	45
1989	7,383	44
1990	7,718	36
1991	9,287	46
1992	11,508	49
1993	10,098	51
1994	8,281	44
1995	8,978	40

Source: California Wild Rice Advisory Board.

69 percent of the farms and produced 59 percent of Minnesota's cultivated wild rice (Appendix table 2). Nearly 40 percent of the farmers interviewed reported that wild rice farming was their principal occupation. Another 16 percent were engaged in farming activities in addition to growing wild rice, and the remainder were either retired or engaged in off-farm occupations such as logging (Appendix table 3).

The median-size wild rice farm in Minnesota contained 291 acres of paddies in 1983. However, the larger farms contributed the bulk of the state's production. Farms in excess of 291 acres produced 83 percent of the cultivated output in 1982. Seven farms with more than 1,000 acres accounted for 41 percent of the state's production in that year (Appendix table 4).

In California's Sacramento Valley, wild rice acreage is scattered among rice farmers who switched some of their land from white rice to wild rice. Wild rice was an attractive alternative crop for Sacramento Valley farmers during the early 1980's, when low prices reduced returns from white rice. They were able to switch to wild rice without any additional investment in paddies and equipment (Winchell and Dahl).

Growers in Lake County and in northern California had different backgrounds from those in the Sacramento Valley. In Lake County, growers in 1983 tended to be businessmen who chose to invest in wild rice production. In Shasta and Lassen county, growers tended to be ranchers who diverted low-lying pastureland to wild rice (Winchell and Dahl).

The Wild Rice Market

Supply

Virtually all of the world's wild rice is produced in the United States and Canada. The United States is the leading supplier, producing about 11 million pounds of cultivated wild rice (finished weight) in 1995.[6] In addition, harvesters in Minnesota and Wisconsin typically gather 0.2-0.5 million pounds of lake wild rice annually (Oelke, 1996). Canada also produces between 0.5-1.5 million pounds from its lakes and rivers annually.

Demand

The U.S. consumes most of its wild rice production domestically. Wild rice is considered a gourmet food and

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[6] This amount includes 10.74 million pounds from Minnesota and California, and 200,000 pounds from Idaho and Oregon.

appears to have a relatively limited market. The quantity purchased is relatively insensitive to price swings, especially in the short run.
Because commercial buyers must fill their orders, prices may be driven sharply higher when there are short supplies, before the market adjusts purchases to the quantity available. On the other hand, buyers have little use for additional stocks beyond their current commitments when there are plentiful supplies. As a result, prices may fall sharply before speculators purchase product to hold for future sale.

Prices

No official market prices are published for wild rice. The Minnesota Cultivated Wild Rice Council, however, develops a "consensus" estimate of the season average price per pound for processed wild rice, which the University of Minnesota reports in its annual wild rice research report (University of Minnesota, 1996). Because these prices represent returns for processing and marketing, as well as for green wild rice, they are treated as wholesale prices in this report. Since 1990, these consensus estimates have ranged between $1.65-$1.75 per pound (Table 3).

Farm gate prices can be derived from wholesale prices by subtracting processing and marketing costs and research and promotion assessments (Table 4). Processing costs reportedly are about 34 cents per pound of processed product in California and 35 cents per pound in Minnesota. Representative marketing costs are about 18 cents a pound in Minnesota and 22 cents a pound in California. The assessments are 2.5 cents a pound in Minnesota and 1.3 cents a pound in California.

The farm gate price for finished product is converted to a green weight price by dividing by a processing yield adjustment. Representative processing yield adjustments are 2.5 pounds of green wild rice per pound of finished product in Minnesota and 2.0 pounds in California. Thus, a $1.70 wholesale price translates to a farm gate price of $0.458 in Minnesota and $0.563 in California.[7]

A second source of farm-gate prices is the California Agriculture Commissioners annual reports (Appendix table 5).

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[7] The computation for Minnesota is ($1.70 wholesale price -$0.35 processing charge - $0.18 marketing charge - $0.025 research and promotion assessment) ÷ (2.5 processing weight conversion) = $0.458 farm-gate price.

The Agriculture Commissioner estimates are an average of those reported by a sample of growers responding to survey questionnaires. Wide variations among years in some counties, and a low correlation in

Table 3--Quantity and value of processed wild rice harvested from cultivated fields in Minnesota, 1968-1995

Year	Production	Price	Value
	1,000 pounds	$/lb	Million dollars
1968	36	3.30	0.12
1969	160	2.55	0.41
1970	364	2.80	1.02
1971	608	2.70	1.64
1972	1,496	2.30	3.44
1973	1,200	2.05	2.46
1974	1,036	2.37	2.46
1975	1,233	2.50	3.08
1976	1,809	2.70	4.88
1977	1,031	4.35	4.48
1978	1,761	5.10	8.98
1979	2,155	5.01	10.80
1980	2,320	4.47	10.37
1981	2,274	3.79	8.62
1982	2,697	3.41	9.20
1983	3,200	3.35	10.72
1984	3,600	3.30	11.88
1985	4,200	2.97	12.47
1986	5,100	2.60	13.26
1987	4,200	1.50	6.30
1988	4,000	1.65	6.60
1989	3,978	1.65	6.56
1990	4,800	1.70	8.16
1991	5,300	1.70	9.01
1992	6,100	1.70	10.37
1993	5,300	1.65	8.74
1994	5,300	1.65	8.74
1995[1]	4,300	1.75	7.52

[1] The values for 1995 are estimated.

Table 4--Derived farm gate prices for wild rice in Minnesota and California

	Minnesota	California
	$/pound finished product	
Wholesale price	1.70	1.70
Processing/marketing expenses[1]		
Processing	0.35	0.34
Marketing	0.18	0.22
Assessments	0.025	0.013
Farm gate-wholesale spread	0.555	0.573
Farm gate price	1.145	1.127
	Pounds	
Green weight/pound finished product	2.5	2.0
	$/pound green weight	
Farm gate price[2]	0.458	0.563

[1] Estimates based on discussions with various industry contacts.
[2] Farmgate price for finished product times finished weight per pound of green rice.

estimates across counties, however, lead to questions regarding how these prices could be used in program implementation.

Between 1991 and 1994, for example, the county average price estimates ranged from $0.42-$1.39 per pound. Further, while prices in one county more than doubled from one year to the next, other counties reported declining prices (compare the changes in Sutter County between 1993 and 1994, for instance, with those in Lassen, Shasta, and Yuba counties).

Eleven of the fifteen reported prices, however, fell between 40-70 cents a pound. This range encompasses the post-1990 prices derived for Minnesota and California. Because of its higher processing yield, green wild rice in California likely sells for a higher price than in Minnesota. Consequently, farm-gate prices for California likely fall within the 40-70 cents range, perhaps between 50 and 60 cents a pound.

The Value of Wild Rice Production

The wholesale value of U.S. cultivated wild rice, in terms of processed product, is estimated at between $15-$25 million annually (Table 5). The value of Minnesota's crop ranged from $7.5-$10.4 million between 1990 and 1995, while California's crop value is estimated at $7.1-$12.7 million during that period. The annual value of production in Oregon and Idaho is estimated at $0.1 million and $0.2 million, respectively.

When the farm-level is examined, the value of cultivated wild rice in 1995 is estimated at $12.9 million (Table 5). This estimate was derived from the wholesale value by subtracting processing costs, marketing costs, and research and promotion assessments.[8]

In addition to cultivated production, an estimated 0.5 to 2.0 million pounds (processed weight) of lake wild rice are produced annually in the U.S. and Canada (Nelson and Dahl). Valuing this lake wild rice at $1.70 per pound, a price comparable with the cultivated product, yields an estimate annual value of $0.85-$3.4 million.

[8] The assessment in California is currently $8.00 per acre. This value was converted to a per-pound charge using an estimate of 600 pounds finished yield per acre.

Table 5--Estimated wholesale and farm value of U.S. cultivated wild rice, 1990-95

	Minnesota[1]	California[2]	Idaho[3]	Oregon[4]	Total
	----------Million dollars----------				
Wholesale:					
1990	8.2	7.1	0.2	0.1	15.6
1991	9.0	9.4	0.2	0.1	18.7
1992	10.4	12.7	0.2	0.1	23.4
1993	8.7	12.4	0.2	0.1	21.4
1994	8.7	8.2	0.2	0.1	17.2
1995	7.5	11.3	0.2	0.1	19.1
Farm:[5]					
1990	5.5	4.7	0.1	0.1	10.4
1991	6.1	6.2	0.1	0.1	12.5
1992	7.0	8.5	0.1	0.1	15.7
1993	5.8	8.1	0.1	0.1	14.1
1994	5.8	5.4	0.1	0.1	11.4
1995	5.1	7.6	0.1	0.1	12.9

[1] The wholesale value is from Table 3.
[2] The wholesale value equals California production from Table 1 times Minnesota wholesale price (Table 3).

[3] The wholesale value equals 95,000 pounds times the Minnesota wholesale price.
[4] The wholesale value equals 75,000 pounds times the Minnesota wholesale price.
[5] The farm value is derived from the wholesale value by subtracting processing costs, marketing costs, and research and promotion assessments. The processing charge is 35 cents per pound of finished wild rice for Minnesota and Idaho and 34 cents per pound for California and Oregon. The marketing charge is 18 cents a pound for Minnesota and Idaho and 22 cents for California and Oregon. The research and promotion assessments are 2.5 cents a pound in Minnesota and 1.3 cents a pound in California. There are no assessments in Idaho and Oregon.

Environmental Requirements and Cultural Practices

Climate

Wild rice is adapted to cool climates. It yields poorly in the southern United States, where extreme heat and shorter summer-time day lengths accelerate plant development and maturation, lessening seed production. In addition, the high humidity in the South favors the develop of leaf diseases, such as brown spot.

Wild rice grows well in California's Sacramento Valley, despite the warm climate. Unlike the southern U.S. rice-growing areas, night-time temperatures in the Sacramento Valley are sufficiently low to delay maturity and allow good grain development. Also, heat-tolerant cultivars have been developed for California that result in a good crop despite warm temperatures. The relatively low humidity, which virtually eliminates leaf disease problems, is a further factor facilitating wild rice production in California.

Soils and Paddy Sites

Wild rice grows well on either organic or inorganic soils. In Minnesota, most wild rice fields have been developed on organic peat, ranging from several inches to more than 5 feet deep. In California, wild rice fields generally have clay or clay loam soils.

The paddy site needs to be flat enough to dike and flood during the growing season. In addition, it needs to have an impervious subsoil, such as clay, which retards seepage. The soil also needs to be firm enough to provide a solid footing for heavy field equipment.

Water

Virtually all wild rice is grown in flooded fields. The soil needs to be saturated from the time the seeds germinate in the spring until 2-3 weeks before harvest. The water depth may range from 6-14 inches.

The water depth during the first 8-10 weeks after germination needs to be held at a constant level to assure vigorous plant growth. Variable water depths during this period may uproot young plants or result in weak stems that lodge during water drawdown.

In Minnesota, wild rice requires 24-30 acre-inches of water to produce a crop. Usually, about half of this amount is

supplied by natural rainfall, with the remainder obtained from lakes and streams adjoining the field. Wells can also be used as a supplemental source of water.

In California's Sacramento Valley, about 5 acre-feet of water are needed to produce a crop of wild rice (Williams). Sacramento Valley producers obtain their water from irrigation districts, which obtain water from state and federal water projects.

Wild rice paddies are drained two to three weeks prior to harvesting. Water levels in the paddy may be permitted to decrease slowly during flowering so that very little, if any, water needs to be drained from the field at harvest.

Seed Handling

New fields should be planted with the most shatter-resistant varieties available. Growers can save their own seed for planting, but it needs to be from weed-free fields to avoid introducing noxious weeds into the paddy.

If the seed is to be stored, even for a short time, it must be placed in water to assure germination. Germination is reduced severely if the seed dries to less than 28 percent moisture. Seed for spring planting can be stored in perforated containers and held in tanks filled with cold water (at a temperature of 33^{o} F to 35^{o} F). In Minnesota, containers may be placed beneath the ice in lakes or streams, or in water-filled pits.

Planting

Wild rice may be either spring- or fall-planted in Minnesota. In California, seeding is done in the spring, except in some of the higher elevations, where planting may also occur in the fall. Annual reseeding in the spring is required in the Sacramento Valley because the paddies do not remain moist from harvest to spring. Wild rice loses viability when the seed dries below 28 percent moisture. Nevertheless, annual reseeding is expensive, accounting for two-thirds of cash production expenses.

Fall seeding has the advantage of eliminating the need to store the seed over the winter. California growers have encountered some problems keeping seed viable during storage (Williams, Androus). Improving seed survival during storage is a research priority for the California industry (Androus).

Another benefit of fall planting is that fields are generally drier then than in the spring, making it easier to operate ground equipment. Spring seeding needs to be done as early as possible, and before stored seed begins to sprout. Since the soil may not be solid enough to support ground equipment, spring seeding is usually done over the water with an airplane.

Once a field is seeded in Minnesota, it may be kept in production for three or four years without replanting, as shattering seed from the previous year reseeds the paddy. Even shatter-resistant varieties drop enough seed to replant the field. In fact, it is difficult to shift a field to a new variety in Minnesota because “volunteer” plants, growing from grain dropped by the previous crop, tend to continually reseed the old variety.

Because of this reseeding, Minnesota fields tend to develop excessive plant populations in the second and subsequent years. Growers may reduce plant density by traveling over the paddy with an air-boat equipped with sharp knives that remove portions of the plants. Four plants per square foot is the recommended plant density in Minnesota.

The seeding rate in Minnesota is about 40 pounds per acre. In California, growers plant about 100 pounds of seed per acre. A higher seeding rate is used in California because plants don’t tiller (produce multiple stems) as much as in Minnesota. Also, Minnesota growers must limit plant density more than in California to minimize problems associated with plant diseases.

Fertilization

Plant nutrient requirements vary substantially depending on the type of soil and the available plant nutrients. Because organic soils have a high inherent nitrogen content, the nitrogen requirement is lower on such soils than, for example, on mineral soils. Fertilizer application recommendations include 25-50 pounds of nitrogen (N) on organic soils, and 70 pounds on mineral soils. The phosphorous (P_2O_5) recommendation is 0-40 pounds, depending on soil test results, with 0-60 pounds of potassium (K_2O) recommended. Excessive nitrogen produces tall stalks and increases the risk of lodging.

Rotations

In Minnesota, wild rice tends to be produced continuously for 3 to 4 years. After the fourth season, the paddy may be

replanted to wild rice or it may fallowed for a season. If growers want to change varieties, they generally fallow the land for a year to reduce the incidence of volunteer plants of the most recently-planted variety. Sometimes, growers plant a small grain crop, such as wheat, barley, or oats during the fallow year. Sunflower and buckwheat are other crops sometimes rotated with wild rice.

In California's Sacramento Valley, producers rotate wild rice with white rice. They may also use sugarbeets and other field crops in the rotation.

Harvesting

Harvesting may begin as early as late July for the shattering types of wild rice in Minnesota. For the non-shattering varieties, harvesting begins a week or two later, usually around mid-August.

Fields that have been planted with the shattering types of wild rice are harvested with a multiple-pass harvester that simulates the traditional canoe-and-flail method used by Native Americans. The harvester collects the grain in finger-like troughs that resemble a cluster of parallel, miniature canoes mounted on a special chassis.

The troughs of the harvester are spaced to permit the stems of the wild rice plant to pass between them as the machine moves forward. A revolving reel serves as the flail, knocking the ripe kernels from the plant into the troughs. The stalks, with immature grain still in the seed head, bend and pass beneath the chassis. Subsequent passes are made at two- or three-day intervals to recover additional grain as it ripens.

Non-shattering varieties are harvested with modified rice combines. Even though they are called non-shattering, the grain on the individual stalks of these varieties ripens unevenly, and shattering occurs before all the kernels are ripe. This uneven ripening necessitates harvesting before all the kernels are mature.

Maximum yields of processed grain occur when 35-40 percent of the kernels have turned from green to dark purple-black in color. The moisture content of the grain and the percent recovery are also approximately 35-40 percent at this time.

Processing

Green wild rice harvested directly from the field consists of kernels at various stages of maturity and moisture content which are encased in a tough, fibrous hull. Green wild rice can neither be eaten nor stored as dry grain in this condition. Therefore, the grain is processed to improve the flavor, lower the moisture content, and remove the hulls. Processing consists of separating immature kernels, fermenting or curing, parching, dehulling, and scarifying.

Separating Immature Kernels

Immature wild rice kernels are lighter in weight, have a higher moisture content, and yield less finished product than mature grain. A low yield of the finished product is undesirable because it reduces processing capacity and raises the costs of processing. Therefore, processors separate and discard light-weight kernels, reducing the volume that has to be processed by 20-30 percent.

Curing

Curing or fermentation is a chemical and biological process that helps break down tough hulls and alters the flavor of the grain. Curing involves placing the green wild rice in windrows, 4-6 feet wide and 8-12 inches deep, in an open field. The grain is periodically mixed and watered during the fermentation period to prevent it from getting too dry and to control the temperature. High temperatures encourage the growth of molds and accelerate dry-matter losses.

Curing changes the color of the wild rice kernels from green to brown. Flavor changes considered desirable by some consumers also develop during the fermentation process. In addition, the tough outer hulls deteriorate during the curing period, which facilitates the dehulling process.

The fermentation period normally lasts 4-7 days. However, wild rice may be kept in the fermentation field for as long as three weeks if there is a shortage of processing capacity. Lengthening the fermentation period permits processors to extend the processing season beyond the end of harvest.

Parching

Parching consists of heating the wild rice in a rotary drum to lower its moisture content from approximately 40-45 percent (wet basis) to 7 percent. Most processors operate the parcher so that a slightly toasted flavor is imparted to the grain. Parching usually takes about two hours.

Dehulling

Dehulling consists of removing the fibrous hull surrounding the wild rice kernels. During parching, the kernels shrink, loosening the hull from the kernel. The parched rice is conveyed to a huller, which either knocks or rubs the loosened hulls from the kernels.

Scarification

Most processors scarify the grain after dehulling to remove a portion of the outer layer of the kernel. Scarification reduces cooking time, which is particularly desirable when wild rice is to be cooked with white rice.

Marketing Wild Rice

Lake wild rice is usually sold in small quantities as unprocessed grain at the harvest site. The buyers typically purchase on a commission basis for a processor or wholesaler. Some buyers are brokers, while others purchase the grain and process it themselves (Oelke and others, 1982).

In Minnesota, growers tend to custom-process their grain, selling finished wild rice either independently or through a marketing cooperative. Grower prices, therefore, represent a wholesale price because they include returns for processing, storage, and marketing. Some cultivated wild rice in Minnesota also is sold as unprocessed grain.

Reportedly, more than 80 percent of the cultivated wild rice produced in Minnesota is marketed through three cooperatives: United Wild Rice, Minnesota Wild Rice Growers, and New Frontier Foods, Inc. (Oelke and others, 1992). Two major buyers of wild rice in Minnesota are Busch Agricultural Resources, Inc., and Uncle Ben's, Inc.

California growers typically sell wild rice to processors as unprocessed grain. Processors often contract with growers prior to spring planting for a specified acreage and, in some cases, a specific price. In other cases, a minimum price is stipulated and upward adjustments are made if warranted by market prices at harvest-time.

A common contracting practice in California involves payment of a base price for grain with a 50 percent processing yield. An adjustment of one cent a pound is then made for each percentage point the processing yield is above or below 50 percent.

Costs of Production

Planting expenses represent a significant share of both cash and total costs, as shown in the costs of production budgets in Appendix A. Planting costs are higher in California because seeding rates there are more than double those in

Minnesota. In fact, seed is the biggest single expense item in California and for first-year production in Minnesota.

Harvesting costs, as shown in the budgets, are substantially higher in Minnesota than in California. The reason for this difference is that Minnesota growers typically sell processed grain, whereas in California, growers sell green wild rice. As a result, Minnesota's production costs include processing charges, while those for California do not.

Differences in production costs between the two states also appear in the categories of irrigation, pest control, miscellaneous costs of production, and in the payment of processing fees.

Production Perils

Major causes of low wild rice yields include inadequate water with which to flood the paddies; uncontrolled flooding that washes out dikes and destroys young plants; wind storms which increase shattering and cause lodging; and hot, humid conditions which promote leaf diseases. Yield losses from most other perils usually do not reach an economic threshold level if recommended production practices are followed.

Drought

Wild rice yields can fall to zero if growers do not have adequate water to keep the paddies flooded during the critical growing period. Some Minnesota growers depend partly on local run-off for irrigation water, storing water in ponds until they need it to flood their rice paddies. During years with a shortage of rain and snow, such growers may not have the water needed for adequate flooding. Drought was cited as the major cause of yield losses in 1988, and $1.2 million in ad hoc disaster payments were made to Minnesota growers as a result (Holen).

Drought losses are more likely to occur in Minnesota than in California. In California, growers plant in the spring, and usually know at that time whether they will be allotted enough water to keep their wild rice paddies flooded during the growing period. In Minnesota, however, wild rice tends to be seeded in the fall, and growers do not know at that time whether the rainfall during the ensuing winter and spring will provide enough water to produce a crop.

Flooding

Spring flooding can wash out dikes and delay planting, or tear wild rice plants from the soil and wash them away (Oelke). Flooding is a potential problem in both California and Minnesota.

Excessive Rains

In addition to flooding, excessive rain in late summer keeps the soil saturated at harvest-time, and it may be too soft to carry a combine harvester. Delayed harvesting due to saturated soils increases shatter losses. Excessive rain during the growing season may also contribute to the development of leaf diseases.

Winds

High winds are particularly damaging to wild rice as the grain approaches maturity. High winds sway the seed heads back and forth, causing the heads to strike one another and the mature kernels to drop to the ground. In addition, wind causes stem breakage and exacerbates losses due to lodging.

Extreme Heat

Extreme heat accelerates plant growth and the maturity cycle. When wild rice plants mature rapidly, they produces fewer seed heads and fewer seeds in each head. In addition, excessive heat, in combination with high humidity, promotes the development of leaf diseases, especially brown spot.

Early Frosts

Early frosts can kill wild rice plants before all of the grain has matured. Dead plants dry out quickly and become more prone to drop their seeds than when they are alive. Consequently, grain losses increase due to seed shattering. If the plants die, growers need to harvest within several days to avoid excessive shattering.

Fall frost is less of a threat now than in the past because newer varieties of wild rice mature earlier than did older varieties. As a result, growers are more likely to have completed harvest before frosts kill the plants than in the past (Oelke, 1996).

Hail

Hail storms were mentioned as a production peril in Minnesota (Oelke, 1996). The extent of yield loss depends on the type

of damage and its timing. Research at the University of Minnesota indicates that simulated hail damage during the flowering, milk, and soft dough stages reduced yields up to 80 percent compared to undamaged control plots (University of Minnesota, 1995).

Hail injury to growing plants lowers their photosynthetic ability and reduces grain fill. Stem breakage stops seed growth and may cause the seed heads to drop into the water. Hail also can cause shatter losses to maturing grain.

Diseases

Diseases are more of a problem in Minnesota than in California. Brown spot is the most common disease affecting wild rice in Minnesota. Stem rot also can be a problem, but causes fewer losses than brown spot.

Brown Spot

All wild rice varieties at all stages of growth are susceptible to brown spot. The disease is most severe when day-time temperatures are between 77^{o} F and 95^{o} F and night-time temperatures are 68^{o} F or warmer. Relative humidity of more than 89 percent and the presence of free water on leaf surfaces for more than 11 hours also promote infection (Oelke and others, 1992; Kernkamp and Kroll). Brown spot has not been a problem in California because of the low humidity in the state's wild rice-producing areas.

Severe infection can result in weakened and broken stems, infected florets, and reduced quality and quantity of seed. Yield losses can range from slight to the entire crop.

Growers can control brown spot by using recommended sanitation practices, such as incorporating crop residues into the soil; using clean seed in new fields; rotating wild rice with brown spot-resistant crops; fallowing the wild rice field; and using non-host plants to stabilize the dikes. The protectant fungicide propiconazole (Tilt) normally provides adequate control in Minnesota. During excessively wet weather, however, brown spot may become widely established despite the use of fungicide.

Stem Rot

Stem rot is the second most common disease affecting wild rice. A fungal disease, stem rot produces lesions on stems or leaves at the surface of the water. Extensive lodging may

result after infected fields are drained prior to harvest. This is because the infected tissues become dry and brittle.

The principal controls for stem rot consist of burning, removing, or incorporating plant residues into the soil. Such practices reduce the pathogen's ability to survive through the winter. Using clean seed and planting resistant crops in rotation with wild rice or fallowing the soil for a season between crops also helps reduce the incidence of infection. There is no fungicide available for effective control (Oelke and others, 1992; Kernkamp and Kroll).

Other Diseases

Stem smut, ergot, and bacterial leaf streak are sometimes serious problems in natural wild rice stands. Although these diseases are known to have infected cultivated stands, economic losses from these diseases have not been a problem in either Minnesota or California and no specific controls are recommended (Oelke and others, 1992).

Insects

Riceworms, rice stalk borers, and midges are the only insects having economic significance in Minnesota wild rice production (Oelke, 1996). In California, midges and rice water weevils attack wild rice, but neither insect causes losses of economic significance (Williams).

Riceworms

The riceworm is potentially the most destructive insect pest of wild rice in Minnesota, but it is not a problem in California. Severe infestations can reduce yields to a negligible level. The adult moths emerge during late June or July and feed primarily on nectar from milkweed flowers. They deposit their eggs, however, in wild rice flowers, where the larvae feed on wild rice kernels.

Malathion, at one pound of active ingredient per acre, is the only insecticide approved for use in controlling riceworms in Minnesota. It is applied 14-21 days after eggs become visible at the base of the florets. Control is considered economical only if there are 10 or more larvae per 100 flower clusters (Oelke and others, 1992; Peterson and others).

Midges

Severe damage to some first-year stands occurs in Minnesota as a result of high populations of midge larvae. The larvae feed

on the plant’s leaves and cause frayed leaf edges, with subsequent curling of the leaves. This leaf curling and webbing impedes seedling emergence above the water. As a result, the stand is thinned severely and the plant population falls below the desired level. Yield losses occur when the plant population falls below 4 plants per square foot. Malathion may be applied to control midges during the stand's first year (Oelke and others, 1992; Peterson and others).

Although midge populations usually increase in following years, control is not necessary since there usually are no associated economic losses. The reason is that the number of plants also increases in subsequent years, and the midge damage typically goes unnoticed.

Rice Stalk Borers

Stalk borers and rots associated with stalk borer injury may weaken the stalks and make them subject to lodging following heavy rains or strong winds. Experiments indicate that the rice stalk borer causes relatively little yield loss, even in paddies which have 30-50 percent stem infestation (Peterson and others). There are no pesticides approved for controlling stalk borers. Cultivating the paddies soon after harvest and using sanitation along ditch banks, together with natural control parasites, appear to provide adequate control.

Additional Insects

Rice water weevils, rice leafminers, rice stem maggots, and other insects occasionally feed on wild rice plants. Research in Minnesota, however, does not reveal any economic injury from these insects.

Wild rice, like other grasses, harbors a number of insects. Some of these may become abundant at times, but are not known to be of economic significance. These insects include aster leafhoppers, several species of aphids and thrips, leaf beetles, and several species of weevils.

Predators

Blackbirds are the most serious predator of wild rice. Not only do they feed on the kernels, they cause the grain to shatter as they fly from stalk to stalk. Water birds and various animals may cause occasional damage, but none of these predators are viewed as serious.

Blackbirds

Blackbirds are the major wild rice predator in both Minnesota and California. They use the paddy dikes as nesting sites and are present in large numbers in the growing areas. Blackbirds begin feeding on wild rice when the kernels are in the milk stage and continue until the grain is harvested. In addition to feeding losses, blackbirds increase shattering as their activity knocks ripe grain from the seed heads. Blackbirds always cause some yield losses, but their damage can become significant if control measures are not taken.

To be effective, growers need to take control measures as soon as the birds are first observed in the area. Numerous methods of bird management may be used, including shooting, carbon-dioxide guns or bangers, "Av-Alarm" records, and continuous overflight by aircraft. Oats may be planted around the perimeter of fields to draw birds away from the wild rice. No methods, however, have been completely effective in keeping blackbirds away from wild rice paddies.

Crayfish

Crayfish, which are carried into paddies by flood waters, may cut back the wild rice seedlings as they forage. Once crayfish are established in a field, they persist and can increase in number. They survive in the field by burrowing into moist soil between periods of paddy flooding. Severe stand reductions have occurred in some Minnesota fields. No chemical controls are approved for the control of crayfish.

Water Birds

Wild rice fields are ideal sites for ducks and other migratory and resident water birds to rest, forage, nest, and raise their young. Nevertheless, waterfowl rarely cause economic damage to wild rice.

Mammals

Raccoon, mink, and skunk forage for food on dikes and in ditches near wild rice paddies. Deer and moose are occasionally sighted in the paddies (Oelke and others, 1982). Large animal activity occasionally damages the crop, but seldom enough to be economically important. Muskrats can cause problems by feeding on plants and by burrowing holes in the sides of dikes. Drainage of the fields at harvest time, however, renders the paddies unsuitable for permanent muskrat residences. Thus, muskrats generally do not pose a risk for the dikes.

Weeds

Weeds are more troublesome in Minnesota's wild rice growing area than in California. Broadleaf water weeds, common in the upper Midwest, usually create the most serious problems. The most prevalent weeds include common waterplantain, cattail, burreed, common arrowhead, cursed crowfoot, and water starwort. Weeds can cause significant yield reductions if they are not controlled.

The most troublesome weed in Minnesota is common waterplantain. Experiments conducted by the Minnesota Agricultural Experiment Station indicate that one waterplantain plant per square foot developed from rootstock reduces average yields by 43 percent (Oelke and others, 1992). Waterplantains produced from rootstock emerge from the water before the wild rice, forming a dense leaf canopy that shades the wild rice plants. This situation kills some of the wild rice plants and reduces tillering in others.

Seedling plants of the waterplantain do not injure wild rice. They develop rootstocks, however, which create a problem in future seasons.

In general, weed control consists of a combination of cultural practices designed to reduce the number of weeds surviving from one season to the next, and chemical methods intended to control weeds during the growing season. Fall tillage after harvest will control cattails and reduce the number of waterplantain plants in the soil that survive to the next season.

Other effective methods used to control aquatic weeds include use of weed-free seeds, maintaining a water depth of at least 6 to 10 inches, especially during the first 6 weeks, and fallowing weedy fields for a year. Fallow fields should be flooded in the spring for 6 weeks to ensure the growth of weeds, and then drained and tilled to destroy the weeds before they reseed (Oelke and others, 1992).

Wild Rice Organizations

California Wild Rice Program

The California Wild Rice Program is a state marketing order that supports research and promotion for wild rice. The order is managed by the California Wild Rice Advisory Board, which is composed of elected grower representatives. The board’s activities are funded through producer assessments of $8.00 per acre of wild rice (Androus).

Minnesota Paddy Wild Rice Council

The Minnesota Paddy Wild Rice Council is a state-chartered organization whose purpose is to support production research and promotion for Minnesota cultivated wild rice (Nelson, 1996). The council is funded through assessments based on the poundage of finished rice production. The Council is currently conducting a survey of Minnesota growers to obtain wild rice acreage data by county.

Disaster Assistance for Wild Rice

Ad hoc disaster payments were made available to wild rice growers for losses due to natural causes in each of the years 1988 to 1994. Since wild rice was not eligible for crop insurance in those years, wild rice producers were required to realize a yield loss of at least 40 percent in order to be eligible for ad hoc disaster payments.

Data on ad hoc disasters payments provide an indication of potential high-loss areas. The states and counties with large ad hoc payments from 1988 to 1994 are most likely to face a relatively high risk of loss under a potential FCIC policy for wild rice, and would likely have a relatively high demand for crop insurance.

Disaster assistance payments for wild rice losses totaled $3.2 million over the 1988-94 period (Table 6). The largest payments were made in 1988, at $1.7 million. These large payments were due to drought, which prevented adequate flooding of the paddies, particularly in Minnesota. The aggregate payments over the years 1989 to 1994 did not reach the level paid in 1988.

Total disaster payments for wild rice were made in six states over the 1988-94 period. Minnesota received 80 percent of the total payments. California growers collected 14 percent of the total, and Wisconsin growers received 6 percent. Producers in Arkansas, Nebraska, and New York collected very minor payments for wild rice losses.

Insurance Implementation Issues

Demand for Insurance

There is likely to be substantial demand among wild rice growers for crop insurance, especially in Minnesota. This is because crop failures are frequent in that state due to adverse weather conditions. The potential for a wild rice policy is limited, however, by the small number of growers and the relatively low value of the crop.

Drought, flooding, and wind storms all hold the potential for causing various degrees of crop failure in Minnesota. In addition, long periods of warm, wet weather can exacerbate yield losses due to leaf diseases.

The importance of ad hoc disaster assistance payments in previous years provides an indication of Minnesota growers'

potential interest in crop insurance. Minnesota wild rice farmers

Table 6--Ad Hoc disaster payments for wild rice losses

Year	California	Minnesota	Wisconsin	Total
1988	319,553	1,250,792	109,129	1,679,474
1989	50,109	250,897	56,429	357,435
1990	33,102	80,485	24,774	138,361
1991	34,531	111,606	0	148,438
1992	11,416	95,018	0	106,525
1993	0	472,051	0	472,051
1994	4,036	325,497	0	329,533
Total	452,747	2,586,346	190,332	3,231,817

Note: The "Total" column includes minor payments made to growers in Arkansas, Nebraska, and New York in various years.

Source: U.S. Department of Agriculture. Farm Service Agency. Ad hoc disaster assistance data files, 1988-94. table 6

collected $2.6 million in disaster assistance between 1988 and 1994. The largest portion of these payments were made for the 1988 crop, and were due to a lack of adequate water to keep the paddies flooded. Disaster assistance payments represented an estimated 5-10 percent of the farm value of wild rice production in Minnesota between 1988 and 1994.

There is likely to be less demand for wild rice crop insurance in California than in Minnesota. California growers are less likely to experience crop failures due to drought, and leaf diseases have not been a source of major yield losses. In addition, flooding is less likely to cause production losses in California than in Minnesota.

The bulk of California's wild rice is planted in the spring, enabling growers to adjust acreage according to their water allocations. In Minnesota, most wild rice is seeded in the fall, before water supplies for the subsequent season become evident.

In California, growers only collected $0.5 million in disaster assistance for wild rice from 1988-94. This represented an estimated 1 percent of the farm value of California's wild rice production.

Despite the likely interest among Minnesota's growers in crop insurance, the potential for a wild rice policy is limited by the small number of growers and the relatively small value of the crop. There were only 48 wild rice farms in Minnesota in 1995, operated by 42 entities (Nelson, 1996). Although about 17,000 acres of wild rice are harvested annually in Minnesota, the farm-gate value of the crop is only $5-$6 million.

Moral Hazard

Moral hazard is not likely to be a problem in insuring wild rice. A large portion of the crop is contracted and, as a result, producers are assured a market. In addition, wild rice stores well and can be held for sale in the future if the current market is glutted. In general, wild rice prices are substantially above variable harvesting costs and it is unlikely that growers will encounter an economic incentive to incur a crop failure in order to collect on crop insurance.

Adverse Selection

Adverse selection is most likely to occur in situations where water supplies are unreliable. In 1988, for example, Minnesota growers relying on local runoff experienced more restrictive supplies than those relying on rivers (Vollhaber).

Farmers who depended on local runoff were typically unable to flood their fields in that year.

Reference Prices

There is a notable lack of reliable price information for wild rice, both in Minnesota and in California. The only published prices are ones reported by the Minnesota Paddy Wild Rice Council for processed wild rice and estimated season average grower returns reported by the County Agricultural Commissioners in California.

The Minnesota prices are “consensus” estimates of returns for processed wild rice made by the Council’s directors each year, and are reported annually in a University of Minnesota wild rice research summary. A farm-gate value for green wild rice can be derived from the wholesale price by subtracting processing and other costs beyond the farm from the processed wild rice price.

In California, the values for wild rice reported by the County Agriculture Commissioners represent a farm-gate return. Because of the wide variation in prices from year to year in some counties, and because of a lack of correlation in year-to-year changes among counties, these prices may be difficult to use in program implementation.

Since wild rice is a nonperishable commodity and can be easily shipped from area to area, the wholesale price for California’s wild rice is likely to be about the same as the price in Minnesota. Therefore, it is suggested that the California farm gate price be derived from the Minnesota wholesale price.

The wholesale prices reported by the Minnesota Cultivated Wild Rice Council appear to be easier to use if FCIC decides to offer a wild rice policy. Buyers in both Minnesota and California indicated that they thought the prices reported by the Council are representative of current wholesale prices, and that green wild rice prices derived from these wholesale prices also are representative of actual prices.

Yield Data

Farmers themselves are likely to be the only source of individual yield data. In Minnesota, the Paddy Wild Rice Council records producer assessments, which are based on growers' output of processed wild rice. However, the Council apparently does not record harvested acreage, which would provide the basis to estimate average yields. Likewise,

processors charge producers on the basis of production, but have no need for records of harvested area.

In California, the state marketing order for wild rice (the California Wild Rice Program) has a record of grower acreage on which they base their assessments. However, the marketing order does not collect information on production, which could be used as a basis for determining yields. In some cases, processor invoices may provide adequate documentation of grower output in California.

Some farmers in both California and Minnesota may have good acreage and production records for their own operations. Some wild rice farmers have large operations, and likely have extensive records on acreage and production.

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Appendix table 1--Wild Rice: Number of farms, acres harvested, quantity produced, and acres irrigated, 1987 and 1992

State/County	1992 Farms	1992 Acres harvested	1992 Quantity	1992 Acres Irrigated	1987 Farms	1987 Acres harvested	1987 Quantity	1987 Acres Irrigated
			1,000 pounds				1,000 pounds	
California	35	11,739	14,680	11,739	42	6,560	873	6,560
Modoc	3	--	--	--	3	--	--	--
Sacramento	4	2,225	3,562	2,225	6	981	127	961
Shasta	10	1,624	1,359	1,624	11	1,680	224	1,680
Sutter	9	1,997	2,464	1,997	9	1,943	236	1,943
Yuba	3	579	--	579	3	--	--	--
Other	6	--	3,671	--	--	--	--	--
Idaho	4	665	95	615	3	--	--	--
Minnesota	48	21,717	8,400	21,717	66	24,198	5,859	24,198
Atkin	10	5,174	3,274	5,174	13	5,230	1,174	5,230
Beltrami	15	3,774	1,042	3,774	20	5,573	1,353	5,573

Clearwater	6	5,690	1,799	5,690	6
6,740	1,797	6,740			
Polk	4	3,425	1,349	3,425	6
3,335	861	3,335			
St Louis	3	800	188	800	--
--	--	--			
Other	10	2,854	747	2,854	--
--	--	--			
Other states	3	316	34	316	--
--	--	--			
U.S.	90	34,437	23,209	34,387	115
--	--	--			

-- = Not available.

Source: U.S. Department of Commerce, Bureau of the Census, 1992.

Appendix table 2--Ownership of Minnesota wild rice farms, 1983

Owner type	Number of farms	Percent of farms	Percent of Minnesota production, 1982
Individual	21	36	16
Extended family	19	33	43
Unrelated owners	13	22	33
Absentee owners (hired operator)	5	9	8
Total	58	100	100

Source: Winchell and Dahl.

Appendix table 3--Additional employment of Minnesota wild rice farmers, 1983

Other occupation	Number of farms	Percent of farms
None	22	39
Diversified farming	9	16
Retired	7	12
Blue collar	12	21
White collar	7	12
Total	57	100

Source: Winchell and Dahl.

Appendix table 4--Estimated production of wild rice by size of farm, Minnesota, 1982

Farm size in acres[1]	Number of farms	Production (processed lbs)	Percent of 1982 production	Cumulative percent
0-100	12	100,300	3	3
101-200	10	150,270	5	8
201-300	8	268,960	9	17
301-400	6	217,345	7	24
401-500	5	204,810	7	31
501-750	7	559,100	18	49
751-1000	3	308,800	10	59
1000-over	7	1,234,845	41	100
Total	58	3,044,430	100	

[1] Does not include dikes and ditches.

Source: Winchell and Dahl.

Appendix table 5--Wild rice acreage, yield, and production in California,
selected counties, 1991-94

County	Year	Harvested area	Yield/ acre	Produc- tion	Price	Value
		Acres	-------Tons-------		$/ton	$1,000
Lassen						
	1991	715	0.5	393	1,280	503
	1992	780	0.4	335	2,602	872
	1993	574	0.6	373	2,400	895
	1994	140	0.5	70	900	63
Shasta						
	1991	1,290	0.6	851	1,200	1,022
	1992	1,450	0.7	1,063	1,039	1,105
	1993	1,450	0.6	990	860	852
	1994	1,550	0.7	1,054	840	885
Sutter						
	1991	693	0.7	499	1,308	653
	1992	2,834	0.7	2,126	2,277	4,843
	1993	1,891	0.5	946	1,315	1,245
	1994	1,127	0.6	631	2,776	1,752
Yuba						
	1991	552	0.3	166	1,296	215
	1992	1,021	0.4	459	1,501	689
	1993	671	0.4	322	1,450	467

	1994	--	--	--	--
Other					
	1991	2,692	--	--	--
1,096					
	1992	2,326	--	--	--
771					
	1993	2,237	--	--	--
2,101					
	1994	2,423	--	--	--
2,532					
California					
	1991	5,942	--	--	--
3,489					
	1992	8,411	--	--	--
8,280					
	1993	6,823	--	--	--
5,560					
	1994	5,240	--	--	--
5,232					

-- = not available.

Source: California Agricultural Statistics Service and the County Agricultural Commissioners Reports.

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Appendix A

Wild Rice Budgets

Minnesota

California