

VARIATIONS IN REGIONAL ALFALFA PRODUCTION PRACTICES AND COSTS

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The cost to produce alfalfa commercially in California range as widely as the growing conditions in the various production regions of the state. By using variation in climate and soil, the state can be divided into six major production areas (Figure 1): The northern mountain counties, the coastal valleys, the Sacramento Valley, The San Joaquin Valley, the high desert and the southern deserts (Klonsky and Flint). In order to compare the production practices and associated costs across regions, crop budgets were developed for a typical farm scenario for each region. The crop budgets were developed with the assistance of University of California farm advisors and information from local agribusiness firms. The coastal valleys were not included in this analysis due to lack of current information.

The remainder of this paper presents a comparison of the five hypothetical farm budgets in order to identify general differences. Practices described are based on those considered typical for alfalfa in the area. However, practices and costs vary within regions as well as across regions. No attempt is made to quantify variation within regions.

Stand Characteristics

Stand characteristics in the representative studies show tremendous variations as well as some similarities across regions. Stand life in the northern counties is the highest at 7 years while the southern desert is lowest at 3 years (Table 1). The Sacramento Valley, San Joaquin Valley and the high desert all range fairly closely together at 5 years, 4 years and 5 years of stand life, respectively. The annual number of cuttings seems to influence the number of years the stand can stay in production. The more cuttings per year decrease the life of the stand while fewer cuttings allow for a longer stand life.

Those regions with the longest growing seasons have the most cuttings and are in the southern end of the state. The San Joaquin Valley, high desert and southern desert typically have seven cutting of hay per year. The Sacramento Valley with a shorter growing season generally achieves 6 cuttings. The northern counties have the shortest growing season. Confined to the late spring, summer and early fall, this area manages the fewest cuttings, only 3 annually.

Though the northern counties have the fewest number of cuttings of hay per year, they have the largest yield per cutting. With 2 tons per acre per cutting they are significantly higher than the next closest regions. Both the San Joaquin Valley and the high desert harvest 1.3 tons per cutting, followed by the Sacramento Valley with 1.2 tons per cutting and the southern desert producing 1.1 tons per cutting.

Annual yields for California range from 9 tons per acre in the San Joaquin Valley and high desert to a low of 6 tons per acre for the northern counties. The differences between the regional annual yields is due to the longer growing season in the south. However, the northern counties are second only to the high desert for the top total yield over the life of the stand because of the stand's longevity. The high desert harvests 45 tons per acre of hay over the 5 years it's stand is in production while the northern counties yield 43.5 tons per acre over 7 years. It should be mentioned that the yield for the northern counties' includes a 1.5 ton harvest during the establishment year. It is the only area to cut hay during the establishment year.

Description of Hypothetical Farms

The hypothetical farms used to develop the crop budgets for the northern counties, the San Joaquin Valley and the high desert used in this analysis are based on land owned by the grower. The other two hypothetical farms for the Sacramento Valley and the southern desert are based on rented land. It should be noted that rented land and owner - operator arrangements are both common throughout California.

The northern county study is based on a 500 acre field crop operation of which 429 acres are producing alfalfa and 71 acres have a stand being established in any given year. The Sacramento Valley study is based on a 200 acre farm growing only alfalfa hay. A 1,200 acre field and row crop farm is used in the San Joaquin Valley cost study. Three hundred acres of the 1,200 acres are dedicated to growing alfalfa. Other crops grown on the same acreage in rotation with alfalfa hay might include cereals, sugar beets, silage corn, field corn and cotton.

The example used for the high desert cost study is based on a 480 acre field crop farm consisting of three quarter sections of 160 acres each. A center pivot irrigation system is used in each of the three 160 acre fields. Due to the loss of acreage from using a center pivot irrigation system, only 120 acres of each 160 acre field is under cultivation for a total of 360 acres out of the 480 acres under cultivation. Three hundred of the 360 cultivated acres are dedicated to growing alfalfa. The remaining 60 production acres are used to grow cereal and sudangrass in rotation with the alfalfa hay.

Production Costs

The cost to produce a ton of alfalfa hay can be divided into 3 main categories. These are operating, cash overhead and non-cash overhead costs. The resources used and the associated costs for each of these categories will be described in detail below and comparisons drawn across regions.

Operating Costs

Operating costs are the sum of the cultural costs, harvest costs and post harvest costs. The operating costs in the three regions of the Central Valley are about \$320 per acre (Table 2). This means that the operating cost per ton decreases as you move south through the valley because the yield per acre increases. The costs on a per acre and per ton basis are highest in the two desert regions despite high yields because of the high cultural costs in the desert regions, the high harvest cost in the southern desert and the high water cost in the high desert.

Cultural costs - Cultural practices which include pesticide, labor and fertilizer inputs for the production of alfalfa hay vary considerably from region to region (Table 3). Of course, it is important to remember that costs vary from field to field within a region.

The highest cultural cost per acre is for the high desert (\$319 per acre) primarily because of the high labor cost for the center pivot irrigation system and the use of 7 acre feet of water per acre compared to only 4 acre feet in the valley and 2 acre feet in the northern counties. (Table 4).

The cultural costs for the southern desert are higher than the costs for any of the other regions (with the exception of the high desert) primarily because all of the operations are charged at custom rates. The other studies only include the cost of labor, fuel and repairs in the cultural costs and not the cost of equipment ownership. Custom rates implicitly include the cost of depreciation and interest on to the farmer. A more detailed description of the cultural practices included in this analysis follows.

In the northern counties gopher control in an established stand is done in March with bait and applicator two acre-feet of water are applied in eight irrigations from May through September. A total of 2 acre-feet of water are applied at a cost of \$24 per acre-foot. Water is pumped from two wells through wheel line sprinklers. Soil residual herbicides for winter

weed control are applied in January to established stands. Summer grass control may be needed. A phosphorous and sulfur fertilizer is spread on the stand in October.

For the Sacramento Valley, 4.25 acre-feet of water is applied in twelve irrigations from March through September. Water is supplied by an irrigation district and applied to the field through an underground mainline to alfalfa valves to flood the stand between borders. Pest control is managed with four aircraft applications of insecticides. Weevils are sprayed in February and March while worms are treated in July and August. Post-emergent herbicides are applied to seedling stands when needed. Soil residual herbicides for winter weed control are applied in December to established stands. Summer grass control may be needed.

The Joaquin Valley applies four acre-feet of water in eight irrigations from April through August. Water is pumped from two wells through an underground mainline to alfalfa valves to flood the field between borders. Pumped water cost is assumed to be \$25 per acre-foot. Pest control is managed with two applications of insecticides. Aphids and weevils are sprayed in March and worms are sprayed in July. Both spray applications are done by aircraft. Soil residual herbicides for winter weed control are applied in November and December to established stands. Summer grass control may be needed.

Seven acre-feet of water is applied annually in the high desert region, at a cost of \$28 per acre-foot. Water is pumped from three wells to the center pivot irrigation system. Pest control is managed with one insecticide application. Aphids and weevils are sprayed in March. The spray are custom applied. A herbicide is used for grass control as needed. Herbicides for winter weed control are applied in December through early February to established stands. Treflan is used for summer grass and dodder control.

Insect control in the southern desert requires approximately 4 sprays to control weevils, aphids and worms during the growing year. Egyptian alfalfa weevil and pea aphid are controlled in February and March while alfalfa caterpillars and beet armyworms are sprayed for in mid to late summer. Sixteen irrigations apply 6.5 acre-feet of water over the growing season. District water is used at a cost of \$11.50 per acre-foot. The alfalfa stand will have 90 pounds of a phosphorous fertilizer applied each year.

Harvest Costs - Harvesting alfalfa hay in California is done either by the growers that own their own equipment or by custom harvest operators. Growers who harvest their own alfalfa and custom harvesting occur in all areas of the state. If a grower harvests his own hay all equipment for harvest operations should be inventoried, and labor, fuel, repairs, depreciation, and interest on investment costs would be used as the harvest cost. If a grower contracts his harvest operation a custom charge would be used for harvest costs. The costs per acre and on a per ton basis are highest for the northern counties and the southern desert (Table 5).

The northern counties get three cuttings a season and custom swathing, raking, baling and roadsiding the hay costs \$34.00 per ton.

In the Sacramento Valley study the ranch owns its harvesting equipment and performs all of its harvest operations. Six cuttings of hay is normal for the valley, though an seventh cutting is possible in the late fall. If an seventh cutting is harvested, the most likely option is to have it green chopped for a dairy instead of baled. If the seventh cutting is for a dairy, the grower normally pays for the swathing and the dairy is responsible for the rest of the operations. If a green chop is not possible due to distance or other factors, then sheeping off is another possibility.

The farm used in the San Joaquin Valley owns its harvesting equipment and performs all of its harvest operations. Seven cuttings of hay is typical for the San Joaquin Valley and sometimes an eighth cutting is conceivable in the late fall. If there is an eighth cutting it is most likely to be green chopped for a dairy instead of baled. If the eighth cutting is for a dairy, the grower normally pays for the swathing and the dairy is responsible for the rest of the operations. Sheeping off is another possibility instead of having it green chopped.

In the high desert the ranch owns its harvesting equipment and performs all of its harvest operations. Seven cuttings of hay is normal for the area, though some fields are only harvested six times. This study assumes a three twine baler with a twine cost of \$21.50 per box.

All of the harvest operations in the southern desert are custom contracted. Swathing, raking, baling and roadsiding cost \$26.50 per ton. Seven cuttings are harvested during the months March through October. Additionally the alfalfa field can be green chopped or pastured during the winter months but this is not assumed in this study.

Post harvest costs - Post harvest operations include winter weed control and fertilization. The costs are relatively similar in each region ranging from \$22 in the San Joaquin Valley to \$36 in the high desert area (Table 6). The post harvest costs for the southern desert were included in the cultural costs and were not separated out.

Labor Costs - Basic hourly wages for workers range fairly close between regions in the state. 34% is added to the basic rates for SDI, FICA, insurance and other benefits and increases to the labor rates shown below. Two rates are used in each cost study, except for the southern desert, one for machine operators and the other for non-machine operators (field workers). The labor hours for operations involving machinery are 10% higher than the machine hours to account for extra labor involved in equipment set-up, moving, maintenance and repair. Wages for managers are not included as a cash cost. Any returns above total costs are considered returns to management.

The labor rates that follow are for machine and non-machine workers, respectively: northern counties \$7.50 and \$5.00, Sacramento Valley \$9.38 and \$7.04, San Joaquin Valley \$9.38 and \$6.10, high desert \$9.38 and \$6.10 and the southern desert \$5.75 for non-machine labor only. In the southern desert all of the operations involving machinery uses custom rates no machine labor is charged to the alfalfa.

Fuel and Repair Costs - The fuel and repair cost per acre for each operation is determined by multiplying the total hourly operating cost for each piece of equipment by the number of hours per acre for that operation. Prices for on-farm delivery of gasoline and diesel are \$0.79 per gallon and \$1.00 per gallon respectively.

Interest on Operating Capital - Interest on operating capital is based on cash costs and is calculated monthly for nine months until the last harvest at the rate of 11.75% per year.

Cash Costs

Cash costs are the total of operating costs and cash overhead. The total cash costs are significantly higher for the desert regions than the Central Valley (Table 7). These differences are reduced to some extent when the costs are looked at on a per ton basis.

Cash Overhead

Cash overhead includes county taxes, insurance and office expenses (Table 8). Cash rent for land is not included in cash overhead so that the costs are more directly comparable between budgets that were developed based on an owner - operator situation and those that assumed the land was rented (see the discussion on land costs above).

County taxes are calculated as 1% of the average value of equipment, buildings and improvements. Insurance is charged at 0.5% of the average value of the equipment over its useful life. Office and business costs are estimated at \$30 per acre. These expenses include office supplies, telephones, bookkeeping, accounting, legal fees, road maintenance, among others.

Non-cash Overhead

Non-cash overhead is the annual cost of durables with a life of over one year. This category includes equipment, buildings and irrigation systems. It also includes the stand itself because the cost of stand establishment occurs in a single year but must be spread out over the multi year life of the stand.

The purchase of these durables may be equity or cash financed or, most likely, a combination of the two. In either case, the annual cost can be calculated as the sum of annual depreciation and interest.

The non-cash costs for each region are shown in Table 9. The cost for the southern desert is significantly lower than for any of the other regions because it does not include ownership costs for any equipment except for irrigation. This follows from the assumption that all operations are custom hired.

Stand Establishment - Stand establishment are those costs associated with ground preparation, planting and growing an alfalfa stand until the first production year. The costs are quite similar in each budget, ranging from \$525 to \$590 per acre with the exception of the high desert at \$859 per acre (Table 10). The cost of establishment in the high desert is high because of the relatively high land cost and cost of the center pivot irrigation system compared to flood irrigation in the other regions.

Establishing alfalfa in the northern counties is unique compared to the rest of California in that the stand is planted in mid summer and the first cutting of hay occurs in September of the establishment year. All of the primary tillage, seedbed preparation, fertilization and weed control are done in July. 2 acre-feet of water is applied during the months of July, August and September. One cutting of hay is harvested in September yielding 1.5 tons per acre.

In July of the establishment year the ground is first chiselled deep followed by disking or plowing twice in August. Phosphorus, potassium and sulfur fertilizers are then custom applied. The field is laser planed once every 8 years. The field is disced lightly and landplaned in order to touch up minor high and low spots. Borders are prepared just before planting. In September the seed is flown on the field and followed by a roller and an irrigation, though some growers will seed in late winter or early spring. A total of 3 irrigations may occur during the establishment year in the months of September, October and April. Herbicides are applied to control weeds during stand establishment in December and March. Weevils are also sprayed for in March. All of these pest sprays are applied by airplane.

The San Joaquin Valley starts land preparation in August by twice stubble disking the previous crop's residue and following up by laser planing. The field is chiselled followed by a custom application of a phosphorus fertilizer and a pre-plant herbicide. The seedbed is finished with a final disking using an disc harrow and borders are put up. Eight acre inches of water is flood on the field as a pre-irrigation prior to planting. Planting is done in October and a cultipacker is used to cover the seed. A post-emergent herbicide is applied to the seedling stand in March of the following year.

All of the primary tillage and land preparation operations for the high desert are done in September. Fertilizer is custom applied to the field in September before the alfalfa stand is planted in October. A total of 1 acre-foot of water is applied during stand establishment starting with a pre-irrigation in September. The rest of the irrigations are scheduled during the

months of October, November and December. A post-emergent herbicide is applied to seedling stands when needed.

Soil preparation in the southern desert starts with a plowing or subsoiling followed by 2 discings. 260 pounds of a phosphate fertilizer is then applied. The borders are then built and a pre-irrigation of 1/2 acre-foot is put on the field. Two more discings precedes 2 passes over the field with a landplane. Additional border touch up is done before the field is floated. pre-plant herbicide application controls immediately before planting. A spotted alfalfa aphid resistant variety is sown at a rate of 20 pounds per acre in September through November. A total of 1 acre-foot in 2 additional irrigations is applied for the rest of the establishment year. One insect control spray is used.

Land - Three of the five crop budgets used in this analysis, the northern counties, the San Joaquin Valley and the high desert, are based on land owned by the grower. Prices for purchasing alfalfa ground vary greatly in the different regions; \$1,500 per acre in the northern counties study, \$2,000 per acre in the San Joaquin Valley and \$3,300 per producing acre in the high desert.

As described above, the example used for the high desert cost study is based on a 480 acre field crop farm with producing acreage of only 360 acres due to the loss from the center pivot irrigation system. This means that for every acre in production there is 1/3 of an acre that is not producing but must be charged to the alfalfa operation. Therefore, for land valued at \$2,500 per acre, the land cost for alfalfa production is \$3,333 per producing acre ($\$2,500 \times 1.33$).

The annual expense for land owned by the grower is calculated as interest on investment and is not depreciated. Specifically, it is the purchase price multiplied by the opportunity cost interest rate. A value of 12.05% is used in each of the studies to reflect the value of interest foregone by tying up capital in land.

The crop budgets for the Sacramento Valley and the southern desert include the cost of rented land rather than owned land. The costs are \$100 and \$190 per acre, respectively.

Investments - The investments are those that are partially or completely allocated to the alfalfa hay operation. Costs of investments such as stand establishment and hay barn are attributed only to alfalfa hay and cannot be spread over the rest of the farms operations. Other investments including land, shop buildings and irrigation systems can be used by the whole farm so only a portion of the costs can be assigned to the alfalfa hay operation and the rest of the costs are distributed to the other farm enterprises. Annual investments shown represent depreciation and opportunity cost for each investment on an annual per acre basis.

Interest on Investment - Interest is also charged on investment at 12.05% per year to account for income foregone that could be received from an alternative investment (opportunity cost) and is based on the average value of the buildings and equipment.

Equipment Costs - In allocating the equipment costs per acre, the following calculations were made: (a) **Original Cost** of equipment is the cost of new equipment plus sales tax. (b) **Depreciation** is straight line with a ten percent salvage value. (c) **Interest** on investment is calculated as the average value per acre of the equipment during its useful life ($\text{average value} = (\text{new cost} + \text{salvage value})/2$ on a per acre basis) multiplied by an interest rate of 12.05%. (d) **Total Investment Costs** are calculated as 50% of the depreciation and the interest costs for all new equipment to reflect a mix of the new and used equipment.

Conclusion

Production practices and associated costs vary throughout California because of soil conditions, climate and pest pressure. The highest costs are in the high desert area because of high land costs, center pivot irrigation system and high application rate of water (Table 11). The other regions have similar total costs per ton.

Cultural costs in the northern counties are low because of a shorter growing season that requires less inputs. The high desert has the largest cultural costs due mainly to their high irrigation costs. Because of the long growing season in the southern desert more inputs are used thus raising that region's cost over the Sacramento and San Joaquin Valleys.

Growers that do their own harvesting tend to have lower harvest costs per ton than growers that custom hire. The northern counties have a custom rate per ton and tonnage per harvest that are higher than most of the other regions which accounts for its high harvest costs.

Non-cash overhead accounts for interest and depreciation on all of the farms investments except for land. Since the northern counties have a small amount of investments and the southern desert has all of its cultural and harvest operations custom contracted, they have the lowest non-cash overhead costs. At the other extreme the high desert has a significant amount of capital invested in the center pivot irrigation system. Both the Sacramento and San Joaquin Valleys own their own equipment and have comparable size investments which is why their costs are so similar.

Land costs are another area of significant differences between the regions. Rented land has a much lower annual cost than owned land. The high desert has the most expensive land due again to the center pivot irrigation system which leaves land out of production.

The total cost per acre is not as important as the cost per ton when looking at cost differences. While the northern counties and the Sacramento Valley have similar cost per acre their cost per ton is \$16 different. The most expensive region to grow alfalfa hay in is the high desert which is saddled with expensive land and irrigation system. The San Joaquin valley manages to produce alfalfa hay at the lowest cost followed very closely by the Sacramento Valley. The southern desert is close behind but has higher cultural and harvest costs than either the San Joaquin or Sacramento Valleys.

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MAJOR ALFLAFA PRODUCTION REGIONS IN CALIFORNIA

Figure 1

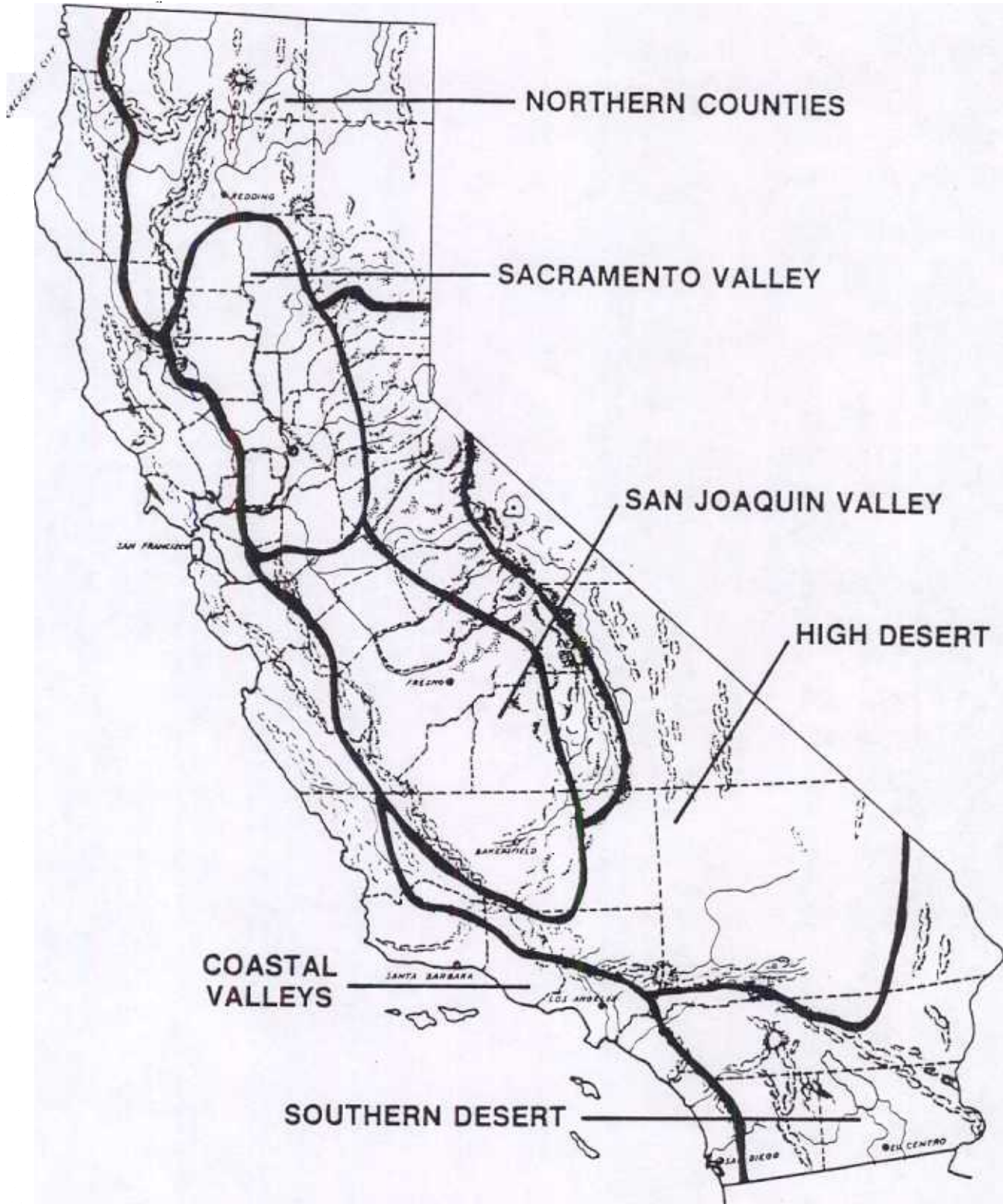


Table 1. REGIONAL COMPARISON OF ALFALFA STAND CHARACTERISTICS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Stand Life (yrs)	7	5	4	5	3
Annual Yield (tons/ac)	6	7	9	9	8
Total Yield (tons)	43.5*	35	36	45	24
Cuttings/Year	3	6	7	7	7
Cuttings/Stand Life	22	30	28	35	21
Tons/Cutting	2.0	1.2	1.3	1.3	1.1

* Includes 1.5 tons of hay harvested in the establishment year

Table 2. REGIONAL COMPARISON OF ANNUAL OPERATING COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$321	\$319	\$326	\$502	\$499
Cost/Ton	53.50	45.51	36.21	55.78	62.41
% of Production Costs	43.1%	42.3%	35.4%	34.6%	50.8%

Table 3. REGIONAL COMPARISON OF ANNUAL CULTURAL COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$79	\$160	\$148	\$319	\$238
Cost/Ton	13.24	22.85	16.39	35.49	29.69
% of Production Costs	10.7%	21.2%	16.0%	22.0%	24.1%

Table 4. REGIONAL COMPARISON OF ANNUAL WATER COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Water Applied (Acft)	2.00	4.25	4.00	7.00	6.50
Cost/Acft	\$24.00	\$25.00	\$25.00	\$28.00	\$11.50
Cost/Acre	48	106	100	196	75
Cost/Ton	8.00	15.18	11.11	21.78	9.34
% of Production Costs	6.4%	14.1%	10.9%	13.5%	7.6%

Table 5. REGIONAL COMPARISON OF ANNUAL HARVEST COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$204	\$123	\$144	\$122*	\$209
Cost/Ton	34.00	17.56	16.02	13.58*	26.13
% of Production Costs	27.4%	16.3%	15.7%	8.4%	21.2%

* Harvest cost includes swathing, baling & roadsiding, but not raking

Table 6. REGIONAL COMPARISON OF ANNUAL POSTHARVEST COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$29	\$26	\$22	\$36	\$0*
Cost/Ton	4.84	3.66	2.46	4.05	.00
% of Production Costs	3.9%	3.4%	2.4%	2.5%	.0%

* Postharvest cost included in cultural cost

Table 7. REGIONAL COMPARISON OF ANNUAL CASH OVERHEAD COSTS *

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$68	\$44	\$72	\$104	\$62
Cost/Ton	11.28	6.33	7.97	11.56	7.77
% of Production Costs	9.1%	5.9%	7.8%	7.2%	6.3%

* Does not include land rent

Table 8. REGIONAL COMPARISON OF ANNUAL TOTAL CASH COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$389	\$263	\$398	\$606	\$561
Cost/Ton	64.78	37.56	44.18	67.33	70.18
% of Production Costs	52.2%	34.9%	43.2%	41.8%	57.1%

Table 9. REGIONAL COMPARISON OF ANNUAL NON-CASH OVERHEAD CASH COSTS *

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Cost/Acre	\$175	\$291	\$282	\$442	\$232
Cost/Ton	29.24	41.53	31.28	49.10	29.05
% of Production Costs	23.6%	38.6%	30.6%	30.5%	23.6%

* Does not includes cost for land

Table 10. REGIONAL COMPARISON OF ALFALFA STAND ESTABLISHMENT COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Total Costs/Acre	\$524	\$585	\$548	\$859	\$590
Stand Life	7	5	4	5	3
Annual Cost/Acre	106	152	170	223	232
Annual Cost/Ton	17.75	21.76	18.89	24.83	29.05
% of Production Costs	14.3%	20.2%	18.5%	15.4%	23.6%

Table 11. REGIONAL COMPARISON OF ANNUAL PRODUCTION COSTS

	Northern Counties	Sacramento Valley	San Joaquin Valley	High Desert	Southern Desert
Tons/Acre	6	7	9	9	8
Cultural Cost	\$79	\$160	\$148	\$319	\$238
Harvest Cost	204	123	144	122	209
Postharvest Cost	29	26	22	36	0
Interest on Operating Capital	8	10	17	24	26
TOTAL OPERATING COST	321	319	331	502	473
Cash Overhead Cost	68	44	72	104	62
TOTAL CASH COST	388	363	403	606	535
Non-Cash Overhead Cost	175	291	282	442	232
Land Cost	181	100	241	402	190
TOTAL COST/ACRE	745	754	925	1,450	957
TOTAL COST/TON	124	108	103	161	120