ANALYSIS OF IRRIGATION

in the

LAST CHANCE CREEK WATER DISTRICT

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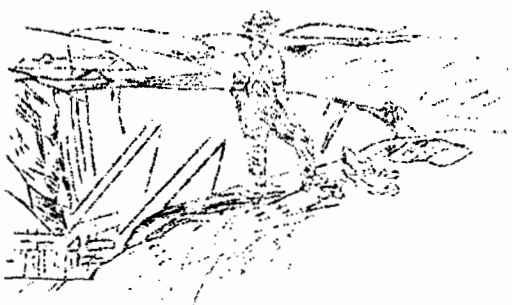

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SUMMARY

This report covers a short study of the water use and economic feasibility or additional water for use in the Last Chance Creek Water District.

Hay and pasture are the only crops suitable for production in the area during the forseeable future. Present average yields were estimated at 3/4 ton of hay and 1 animal unit month* of grazing per acre. Estimated net incomes were projected for yields of 2 tons and 3 tons per acre. Three ton yields may be obtainable. Two tons should be a minimum yield, with improved management.

Analysis of the weather data for the area and known uses of water by forage plants common in the hay crops indicates a farm irrigation requirement of 2.7 acre feet of water per acre.

Analysis of income and expenses for hay production indicates a $2.45 loss per acre under present conditions. Yields of 2 and 3 tons per acre gave a balance available for water of $ .50 and $11.00 per acre respectively.

* An animal unit month is the amount of food required for a mature cow for one month or 400 pounds of total digestible nutrients. This is equivalent to .4 ton of hay.

INTRODUCTION

This report summarizes a study of the irrigation water needs of crops grown in the Last Chance Creek Water District and the economic potential to pay for the water. No attempt has been made to analyze the over-all operation of the district or the adjustments needed on individual ranches to make economic use of additional water. The study was based on averages for the district and does not analyze the variability between ranches.

The study on which this report is based assumed that hay would be the only crop irrigated in the area. Present average yields for the area were estimated at 3/4 ton of hay and 1 animal unit month of grazing. Costs were calculated on the basis of owned land and custom rates for the various operations performed. Interest was charged at 5% of the average investment and management was charged at 10% of the gross income. Farm prices of $20 per ton for hay and $4 per A.U.M. of grazing were used in calculating gross income.

CONSUMPTIVE WATER USE

Definition

Consumptive use is defined as the sum of the volumes of water used by the vegetative growth of a given area in transpiration and building of plant tissue and that evaporated from adjacent soil or intercepted precipitation on the area in any specified time, divided by the given area. It may be expressed in terms of acre-inches per acre or inches and acre-feet per acre or feet.

Development of Consumptive Use Data

There are many factors that influence the amount of water consumed by plants. The more important natural influences are climate, water supply, soil and topography. The climatic factors that particularly affect consumptive use are precipitation, temperature, humidity, wind movement and growing season. Irrigation practices also influence the amount of water consumed.

From the results of experimental studies throughout the western United States, an empirical formula has been developed showing the relationship between temperature, length of growing season, monthly per cent of annual daytime hours and consumptive use of water. By using this relationship, consumptive use and irrigation water requirements of crops can be quickly estimated for any area where the necessary climatological and irrigation data are available.

This method is empirical and experience has shown that although the annual consumptive use data are usually within ten per cent of accuracy, any individual monthly use figure may be less accurate. The result is a high use figure computed for early and late in the season and a low use figure for the peak use period.

Briefly, the procedure is to correlate existing consumptive use data with monthly temperature, monthly percentages of yearly daytime hours, precipitation and growing or irrigation season. Coefficients have been developed from existing measured consumptive use and temperature data and monthly percents of yearly daytime hours. Thus, if only monthly temperature records are available and lati-

tude is known, the consumptive use can be computed from the Blaney-Criddle formula U = KF; where U = consumptive use of water in inches for any period, K = emperical consumptive use coefficient, and F = sum of the monthly consumptive use factors for the period (sum of the products of mean monthly temperature and monthly per cent of annual daytime hours).

For Sierra Valley the latitude is approximately 39 1/2 degrees. Temperature data averaged for Sierraville and Portola, the only Weather Bureau stations in the Valley, are used. Precipitation data at the Frank Dotta Ranch near Vinton are available for the past 20 years. The average growing season is from April 15 to September 15. The coefficient K for improved hay and pasture is 0.75. Table 1 uses these factors in developing consumptive use date for the Valley.

Table 1. Consumptive Use of Water
by Improved Hay and Pasture in Sierra Valley

Date	Mean Monthly Temp. t	Per cent of Daylight Hours p	(+p) f	U (.75f)	Rain-fall r	Cons. Use Irrig. Water (inches)
April	43.8	8.95	3.92	2.9	.94	
May	50.1	10.02	5.02	3.8	1.04	3.8
June	56.6	10.08	5.71	4.3	.57	4.3
July	62.8	10.22	6.47	4.8	.36	4.8
Aug.	60.8	9.54	5.80	4.4	.20	4.4
Sept.	54.9	8.38	4.60	3.5	.27	1.8
Total				23.7		19.1

Available Soil Moisture

Laboratory analyses of soils similar to those in the Valley indicate a potential storage of 1 1/2 inches of available moisture per foot depth of soil. The rooting depth of improved hay and pasture crops is about two feet which means the available soil moisture storage capacity is about three inches.

Rainfall during the growing season is shown in Table 1. It is variable, unpredictable and undependable and its effectiveness is unknown. For use in this report, the winter precipitation through April is assumed to be sufficient to supply needed soil moisture through May 1. From May 1 to September 15, consumtive use demands are assumed to be furnished by irrigation.

Water Application Efficiency

In applying irrigation water to soil there are some uncontrolled losses such as deep percolation beneath the root zone and tail water runoff. Tail water can be captured and reused but deep percolation losses usually contribute to groundwater supplies or return to the surface at elevations below the point of use. Under the present wild flooding system of irrigation it is suspected that water application efficiencies of about 30 per cent are realized. That is three times the amount of water needed by the plant at the time of irrigation is applied to the soil. With increased costs of water and land grading with border methods of irrigation installed efficiencies of 60 per cent can be expected. Dividing the consumptive use of irrigation water (19.1) by .6 gives a farm irrigation requirement of about 32 inches or 2.7 feet per season. This represents the amount of water required at the farm headgate providing the headgate is near the place of application of water.

Late Season Water

A certain percentage of the irrigation requirement will be obtained from natural runoff water and a percentage from stored water. The following table indicates the amount of stored water needed for the remainder of the season when the natural runoff water has been depleted.

Table 2. Stored Water Needed
To Complete Season Irrigation Requirement

Date to Begin Using Stored Water	Irrigation Requirement Remaining from Stored Water (feet)
June 1	2.1
July 1	1.5
Aug. 1	0.9

It must be remembered that this represents the water needed at the head of the field and does not include losses in conveying the water from storage or through canals and ditches.

ECONOMICS OF IRRIGATION WATER

The first question that has to be answered in the development of any new irrigation is "How much can be paid for the water?" Professor Frank Adams, one of the recognized authorities on irrigation said in 1949, "It is conceivable that farmers can pay for water to the full extent of the increase in net income resulting from its use.... Ordinarily, however, water costs that do not leave the farmers a substantial increase in his net profits due to the use of the water will not be considered reasonable or feasible." Professor Adams here recognized the economic need for some incentive before farmers will assume the investment and risk involved in changing their production pattern when irrigation water supplies are developed.

This study allows a management charge of 10% of the gross income as an incentive for using the irrigation water. It is assumed, however, that the new irrigation water will be used on land which has been leveled and planted to improved hay crops rather than applied to the natural meadows. Yields which can be expected with this improved management range from a minimum of 2 tons per acre to 3 tons or more. Higher yields are not uncommon in other areas with similar soil and climatic conditions. Income and expenses have also been calculated on the basis of the 2 and 3 ton yields.

Development costs per acre were estimated as follows:

Renovating and Leveling	
Rip sod	$20
Level	35
Total	$55
Establishing Crop Stand	
Land Preparation	$ 5.00
Land Planing	7.50
Check	3.25
Seed and planting	11.00
Irrigate first year	5.00
Misc. cultural work	2.25
Cash overhead	2.50
Non-cash overhead	4.50
Total	$41.00

The following tables summarize the present income and expense situation at 3/4 ton of hay per acre plus estimated income and expense under a 2-ton yield and a 3-ton yield.

INCOME AND EXPENSE FOR HAY PRODUCTION UNDER PRESENT CONDITIONS

Based on a yield of 3/4 ton of hay and 1 A.U.M. of pasture per acre. Labor charged at $1.65 per hour

Income				
Hay	3/4 ton @ $20			$15.00
Pasture 1 A.U.M. @ $4				4.00
	Total Income			$19.00
Expense				
Irrigate	.5 hr. @ $1.65		.85	
Ditch work -	labor .75 hr. @ $1.65	$1.25		
	tractor .2 hr @ 2.00	.40	1.65	
Drag	.22 hr @ $3.65		.80	
	Total cultural			3.30
Mow			1.50	
Rake			1.50	
Bale	3/4 ton @ $5		3.75	
Haul	3/4 ton @ $2.50		1.90	
	Total Harvest			8.65
Taxes on land			1.50	
Misc.			2.50	
	Total Cash overhead			4.00
Land $90 @ 6%			5.40	
Fences $10 @ 6%			.30	
	Depreciation $10 for 20 years		.50	
	Total non-cash overhead			6.20
Management 10% of gross income				1.90
	Total cost			$24.05
	Net income			-5.05

The minus net income situation represented above indicates that ranchers are not now receiving a full 6% return on their investment, or a full 10% return for their management, or a combination of both.

INCOME AND EXPENSE FOR HAY PRODUCTION

YIELD OF 2 TONS PER ACRE

Income

Hay	2 ton @ $20		$40.00
Pasture	2 A.U.M. @ $4		8.00
	Total Income		$48.00

Expense

Irrigate	5 times 5 hrs @ $1.65	$8.25	
Ditch Work		.75	
Drag, etc.		.80	
	Total cultural		9.80
Mow		1.50	
Rake		1.50	
Bale	2 ton @ $5	10.00	
Haul	2 ton @ $2.50	5.00	
	Total harvest		$18.00
Taxes on land		2.75	
Miscellaneous		2.50	
	Cash overhead		$5.25
Land	$90 @ 6%	5.40	
Fences - Interest and Depreciation on $10		.80	
Leveling	$55 @ 6%	3.30	
Stand	$41 @ 6% 1.25		
	Depreciation $41 for 7 yrs. 5.85	7.10	
	Total non-cash overhead		$16.60
Management	10% of gross income		4.80
	Total Cost		$54.45
	Balance available for water		-6.45

INCOME AND EXPENSE FOR HAY PRODUCTION

YIELD OF 3 TONS PER ACRE

Income

Hay	3 ton @ $20		$60.00
Pasture	2 A.U.M. @ $4		8.00
	Total income		$68.00

Expense

Irrigate	5 times 5 hrs. @ $1.65		$8.25	
Ditch Work			.75	
Drag, etc.			.80	
	Total cultural			$9.80
Mow			1.50	
Rake			1.50	
Bale	3 ton @ $5		15.00	
Haul	3 ton @ $2.50		7.50	
	Total Harvest			$25.50
Taxes on land			2.75	
Miscellaneous			2.50	
	Total cash overhead			$ 5.25
Land	$90 @ 6%		5.40	
Fences - Interest and Depreciation on $10			.80	
Leveling	$55 @ 6%		3.30	
Stand	$41 @ 6%	$1.25		
	Depreciation $41 for 7 yrs	5.85	7.10	
	Total non-cash overhead			$16.60
Management	10% of gross income			6.80
	Total Cost			$63.95
	Balance available for water			$4.05

Summary of Residual Available For Water

If a rancher needed to purchase the full 2.7 acre feet of water per acre required for an optimum level of irrigation he could afford according to the preceding figures, to pay the following amounts:

Hay Yield Tons per Acre	Net Per Acre Available for Water	Per Acre Foot
3/4	-$5.05	0
2	-$6.45	0
3	$4.05	$1.50

Ranchers who now have natural runoff water could afford to pay the following amounts for additional water:

Date to Begin Using Stored Water	Additional Water Needed Until Sept. 15	Acre Foot Values at Different Yields	
		2.0	3.0
June 1	2.1 feet		$1.93
July 1	1.5 feet		2.50
August 1	.9 feet		4.50

A 200 COW SIERRA VALLEY RANCH
COMPARISON BETWEEN PRODUCING 3/4 AND 2 TONS OF HAY PER ACRE

Production - 90% Calf Crop - 2% Mortality 12% Replacement	Producing 3/4 Ton Hay Per Acre	Producing 2 Ton Hay Per Acre
Investment -		
Stock - Cows 200 @ $200	$40,000	$40,000
Bulls 8 @ $500	4,000	4,000
Horses 3 @ $150	450	450
Land - 3600 Acres		
Irrigated 360 @ $70	32,400	32,400
Dryland 3240 @ $25	81,000	81,000
Improvements -		
Fence 30 miles @ $500	15,000	15,000
Stock Water	5,000	5,000
Irrigation structures	3,600	3,600
Leveling 360 acres @ $55		19,800
Improved stand 360 acres @ $41		14,760
Equipment -	15,000	15,000
Buildings and Corrals -	25,000	25,000
Total Investment - - - - -	$221,450	$256,010
Income -		
Steers 88 @ 800 lb. - 70,400 @ 24¢	$16,896	$16,896
Heifers 64 @ 700 lb. - 44,800 @ 22	9,856	9,856
Cows 13 @ 1150 Lb. - 14,980 @ 18¢	2,691	2,691
6 @ 750 lb. - 4,500 @ 12¢	540	540
Bulls 4 @ 1500 lb. - 6,000 @ 18¢	1,080	1,080
Hay 150 ton @ $20		3,000
Total Income - - - - - -	$31,063	$34,063
Expenses -		
Feed - Hay raised @ $8 ton	$2,160	$4,560
Hay bought 300 ton @ $22.50	6,750	
Barley 26,300 lb. @ 3¢	789	789
Cottonseed 26,300 lb. @ 4¢	1,052	1,052
Cost of producing hay sold 150 ton @ $8		1,200
Taxes	2,000	2,250
Bull replacement 4 @ $500	2,000	2,000
Water District	720	720
Water Master	40	40
Hired Labor @ $1.65	1,815	4,500
Vet, Medicine, Office, etc.	2,500	2,500
Depreciation - Buildings, equipment, fences	3,595	5,703
Total Cost - - - - - - - -	$23,421	$25,314
Net Farm Income - - - - -	$7,642	$8,749