Irrigated Forage and Livestock Production in the Oregon Columbia Plateau Counties: A Preliminary Report

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IRRIGATED FORAGE AND LIVESTOCK PRODUCTION IN THE OREGON COLUMBIA PLATEAU COUNTIES: A PRELIMINARY REPORT

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I. INTRODUCTORY COMMENTS

Land under irrigation in the Columbia Plateau counties has increased by more than 15,000 acres in recent years. Also plans have been announced to develop more than 30,000 additional acres in the next five years. Accompanying this trend to more irrigation has been a growing interest in profitable cropping alternatives for utilizing this resource and to add diversity to the farm organization. One enterprise which appears to have potential is irrigated forage and livestock production. The objective of this preliminary report is to present information and demonstrate the analysis procedures which farmers, ranchers, and other investors might use in evaluating the feasibility of this enterprise on their irrigated lands.

The case study approach is utilized to provide a framework for relating the relevant information and for applying the analytical procedures used. It is important to note that this is a preliminary analysis. Because irrigated forage and livestock production is a relatively new enterprise to this area, the analysis does not represent actual, existing operations. The information used in this study was obtained from research trials in the Pacific Northwest, observations of farmers and ranchers in the area, and reasoned conjecture. Furthermore, the management practices proposed are based on the assumption that maximum profits from this enterprise will require high levels of forage production.

Because of the differences in soil, climate, and other conditions, two case situations are presented. The first case is on the coarse textured, sandy soils located close to the Columbia River, and utilizes a center-pivot type irrigation system. The second case involves the finer textured, silt loam soil found at higher elevations further from the river, irrigated with a side-roll type system.

Of several possible livestock alternatives, two are selected for economic analysis. The first uses cows and calves to graze the irrigated pasture. Calves are dropped in early spring, and sold at weaning. The second alternative is to graze the forage with yearling steers purchased in February and sold in November.

The format of the report will be to first describe the two case situations, determine the irrigation requirements for each case, present the forage production alternatives, estimate the costs of forage production, consider the livestock production alternatives, budget the livestock costs and returns, and provide some concluding remarks.

II. DESCRIPTION OF TWO CASE SITUATIONS

J. A. Vomocil

Activities in irrigation development have been such that in describing model cases for the region, it is appropriate to delineate two distinct areas, shown on Map II-A.

In general, Area 1 is sandy, with rolling topography varying from 50 to 500 feet above the level of the Columbia River. Area 2 is steeper, more deeply cut with gullies and drainways, and is dominated by fine-textured soils.

Per acre investment for irrigation equipment, taken into consideration with irrigation labor requirements, makes the 1,320-foot center-pivot irrigation system relatively attractive. However, as pointed out below, this system is suitable for <u>some</u>, but <u>not</u> <u>all</u>, of the irrigable soils in the area.

Soil Characteristics

Table II-1 tabulates some characteristics of several extensive soil types found in northern Morrow and Umatilla counties. These soils have been grouped by texture into two categories. Soils in Category A have infiltration capacities of 0.75 inch/hour or greater, while those in Category B have infiltration capacities of 0.15 to 0.70 inch/hour. Usually, soils in Category A are satisfactory for center-pivot systems. However, even in these cases it is recommended that soil infiltration capacity be carefully considered before investment in irrigation equipment is made.

Soil texture and structure affect infiltration capacity, but also influence moisture storage capacity and thereby influence options in irrigation scheduling. Sandy soils, those with high infiltration capacity, have low water-holding capacities and require frequent irrigation. Finer textured soils, those with low infiltration capacities, have higher capacities for storage of readily available water which allows larger, less frequent irrigations. Average moisture storage capacities of four of the major soil series of each area are reported in Table II-1.

Water Supplies

Both surface and ground water can be used in Area 1. At the lower elevations, near the river, the vertical and horizontal distances which river water must be pumped to reach lands to be irrigated are reasonable. Soils in this area are underlain by variable but considerable thicknesses of gravels lying on top of the basalt strata. The gravel layers are relatively near the surface, and are sufficiently porous to permit good flow of ground water to wells. Hence, relatively shallow wells can produce large flows.

On the other hand, as the distance from the river increases in Area 2, elevation increases, and the gravel strata feather out and disappear. Higher on the plateau, wells draw water from low-porosity fractured basalt. Under these circumstances, wells must extend 500 to 1,000 feet below the static water table to attain capacities of 1,000 gallons per minute.

Table II-1. Significant Characteristics of Some Major Soils of the Area

Soil series	Soil class	Depth	Avail. water storage capacity	Infiltration capacity
A. Columbia Basin (Case 1)				
Ephrata	sandy loam	30-60"	4-5"	0.8-1.0
Koehler	loamy sand	20-25"	2.5-3"	0.8-1.0
Quincy	sand & loamy sand	60"+	4-5"	0.8-1.0
Winchester	coarse sand	60"+	3-4"	1.0-1.5
B. Columbia Plateau (Case 2)				
Ritzville	silt loam	60"+	8-10"	0.2-0.4
Sagehill	fine sandy loam	40-60"	7-9"	0.5-0.7
Sagemoor	silt loam	40-60"	9-12"	0.15-0.3
Walla Walla	silt loam	60"+	8-10"	0.15-0.3

The source of water results in considerable difference in the investment required for water development.

Climate

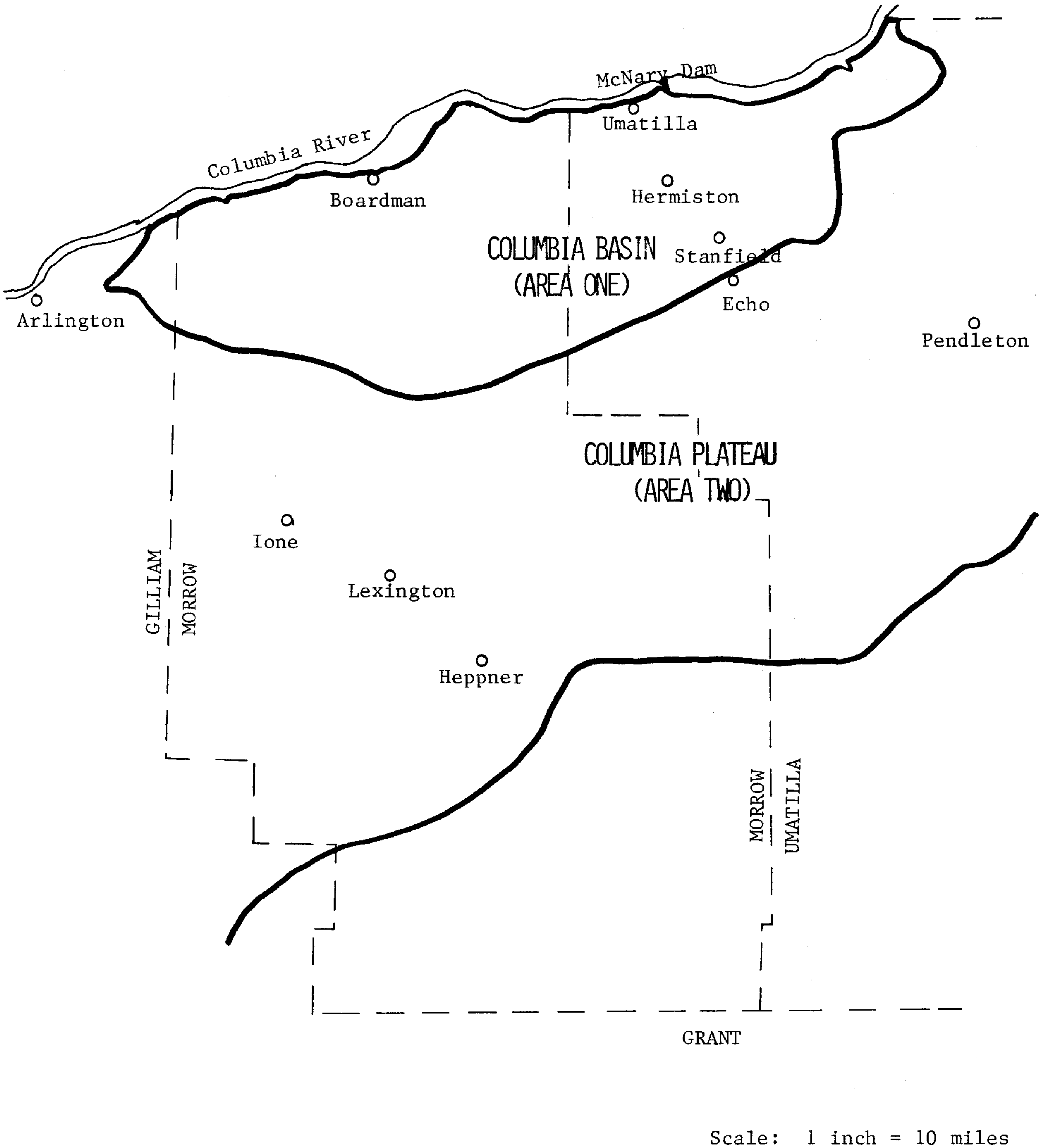
The differences between the Boardman-Hermiston area and the Pendleton-Heppner area are described in Table II-2. The climatic differences are small, but significant.

Irrigation Equipment

Comparison of per-acre investment costs for irrigation equipment and irrigation labor costs makes the 1,320-foot center-pivot irrigation system relatively attractive for areas where it can be used successfully.

The principle of operation of existing center-pivot systems necessitates increasing water application rates from the pivot point toward the periphery of the irrigated circle. Maximum application rate at the outer end of the moving lateral varies with the system selected, sprinkler spacing, and crop requirements. But peak values of 1.5 to 3.0 inches per hour are common at the periphery of quarter-mile systems.

Few soils can absorb water at these rates. Among those that can are the sandy soils found close to the Columbia River in that area identified as Columbia Basin on Map II-A. On finer textured soils, lower infiltration rates will result in ponding and puddling, which will lead to serious crop and water losses. Runoff and erosion losses will also occur.



MAP II-A. Location of Case Study Areas in Morrow and Umatilla Counties, Oregon.

Table II-2. Climates of the Area

A. Case 1 (Columbia Basin)

Average rainfall - 8 to 9 inches
Average 32°+ days - 170 to 200
Temperature, annual average
maximum - 66°
minimum - 40°
Average annual heating degree days -
5050 - 65° base

B. Case 2 (Columbia Plateau)

Average rainfall - 11 to 14 inches
Average 32°+ days - 150 to 170
Temperature, annual average
maximum - 63°
minimum - 40°
Average annual heating degree days -
5500 - 65° base

The finer textured soils in Area 2 are adapted to larger, less frequent irrigations, and can be served with any one of a variety of irrigation systems. Appropriate systems might include linear self-propelled, side-move, side-roll, end-tow, and some traveler gun types. For purposes of this discussion, the side-roll was chosen for the model on the finer textured soils.

The Models

In view of the factors referred to above, two hypothetical case situations are considered in this study of irrigated forage:

Case 1 - Irrigation of a circle (130 acres) of coarse textured, sandy soil close to the Columbia River and at elevations below 800 feet, using a 1,320-foot center-pivot irrigation system. Source of water will be a 1,000 gallon-per-minute well, drilled and lined, 14 inches in diameter, and 150 feet deep. With the pump operating at 1,000 gpm, the pumping level in the well will be 100 feet below ground surface.

Case 2 - Irrigation of a comparable area of forage on a silt loam soil, at a greater distance from the river and at higher elevations, using four 1,320-foot side-roll systems. Source of water will be a 1,000 gallon-per-minute well, drilled and lined, 14 inches in diameter to a depth of 400 feet, and 8 inches in diameter for an additional 600 feet. With the pump operating at 1,000 gallons per minute, the water level in the well will be 300 feet below ground surface.

In both cases an area to receive "part season irrigation" will be included. It is recognized that such an operation described in detail in Chapter III may be too inconvenient for many ranchers to view as practical. Inclusion of it, however, will spread the investment charge for equipment and make the project more economically feasible. Because of the high costs associated with this development, it was felt that every effort should be considered in maximizing the use of equipment purchased.

III. IRRIGATION SYSTEMS AND REQUIREMENTS

J. A. Vomocil

Water needs of crops can be reliably predicted from climatic information. A listing of average quantities of water used, month by month, by various crops in several climatic regions of Oregon is reported in Table 4 of Oregon State University Agricultural Experiment Station Circular of Information 628 (Watts, et al., 1968). In this list are pasture grass and alfalfa for the Hermiston climatic zone and the Pendleton-Heppner zone. Portions of Table 4 (628) are reproduced as Tables III-3 and III-4.

Table III-3. Computed Average Consumptive Use and Net Irrigation Requirement; Hermiston-Boardman

Month	Pasture grass		Alfalfa	
	CU	IR	CU	IR
	in.	in.	in.	in.
January	--	--	--	--
February	--	--	--	--
March	--	--	--	--
April	2.58	1.89	1.92	1.58
May	4.25	3.58	5.14	4.47
June	5.71	5.01	7.01	6.31
July	7.18	6.99	8.66	8.47
August	6.04	5.79	7.03	6.78
September	3.69	3.17	4.20	3.68
October	1.95	1.13	1.00	0.76
November	--	--	--	--
December	--	--	--	--
Seasonal Totals	31.40	27.56	34.96	32.05

Before these values can be used to describe appropriate irrigation schemes for the two cases, several adjustments must be made. These are outlined below.

(A glossary, including greater detail in terminology and definitions, is presented in Appendix A for those who need more precise consideration of any of the adjustment factors.)

The following adjustments were made for converting consumptive use estimates to appropriate irrigation designs:

1. Average consumptive use (Tables III-3, III-4) for irrigated mixed

Table III-4. Computed Average Consumptive Use and Net Irrigation Requirement; Pendleton-Heppner

Month	Pasture grass		Alfalfa	
	CU	IR	CU	IR
	in.	in.	in.	in.
January	--	--	--	--
February	--	--	--	--
March	--	--	--	--
April	1.40	0.78	1.63	1.01
May	3.61	2.23	4.37	2.99
June	4.83	3.62	5.93	4.72
July	6.39	6.08	7.71	7.40
August	6.08	5.70	7.07	6.69
September	3.47	2.70	3.95	3.18
October	1.26	0.67	1.05	0.66
November	--	--	--	--
December	--	--	--	--
Seasonal Totals	27.04	21.78	31.71	26.65

forage (alfalfa-grass) was taken as the average between that for grass pasture and that for alfalfa.

2. Average net irrigation requirement (Tables III-3, III-4) was calculated as average consumptive use minus the average measured rainfall.

3. Net irrigation requirements, 5/10 and 8/10 (Tables III-5, III-6, and Appendix), were calculated for the forage mix, using adjustment factors derived from Tables 4 and 6 of O.S.U. Circular of Information 628.

4. Net peak period use rates (Tables III-5, III-6) were taken from O.S.U. Circular of Information 628, Table 8.

5. Gross application requirements (Tables III-5, III-6) were calculated by assuming a water application efficiency of 80 percent for Case 1, center-pivots on sand, and 70 percent for Case 2, side-rolls on silt loam.

6. System capacities (Tables III-5, III-6) were calculated from gross requirement by assuming a down time of 2 hours out of 24, or approximately 8 percent.

Water Supply Needed

Tables III-3 and III-4, along with Tables B-1, B-2, and B-3 of Appendix B, report the information used in calculating gross applications for alfalfa-grass mixed forage, and capacities required as shown in Table III-5 for Case 1 and III-6 for Case 2.

A peak period system capacity requirement of 8.7 gallons per minute per acre (Table III-5) for July in the Hermiston-Boardman area indicates that a 1,000 gallon-per-minute water supply will not suffice for peak needs of a 130-acre circle every year. There will be periods when plants will suffer moisture stress in Case 1.

On the other hand, 1,000 gallons per minute should be adequate for up to 120 acres in Case 2, the Pendleton-Heppner area. The difference is due to acreage, climate, and soil differences.

Having determined how adequately the 1,000 gallon-per-minute assumed as a starting point for these case studies will meet the peak water requirements, it is now possible to consider alternatives in scheduling and distribution of the water supply.

Capital Investment - Wells, Pumps, and Systems

Case 1. Center-pivot on sandy soils, Hermiston-Boardman Area.

For purposes of economic analysis of this case, the following capital items were stipulated:

1. Well, 150 feet deep, 14 inches in diameter, drilled and lined, at $1.50 per inch diameter, per foot depth.... $ 3,200

2. Pumps, (a) 50 BHP turbine pump to lift 1,000 gpm 100 feet at 75 percent pumping efficiency, with accessories.. $ 4,700

   (b) 75 BHP horizontal centrifugal to increase pressure to 100 psi at 75 percent efficiency..................... $ 6,000

3. Mainline, 2,700 feet of 10-inch buried steel at $3.50 per foot.. $ 9,450

4. Center-pivot sprinkler unit with a rotation time of 32 hours or less...................................... $19,000

Case 2. Side-rolls on silt loam.

In this case, the following capital items were designated for the cost analysis. The size of this operation, formulated to be comparable to the 130-acre center-pivot case, is 116 acres. It includes four 1,320-foot side-roll systems, each to irrigate 29 acres.

1. Well, 1,000 feet deep, with upper 400 feet at 14 inches in diameter and the remaining 600 feet at

Table III-5. Forage Production Irrigation, Case 1. Coarse Textured Soils. Hermiston Climate, 80 Percent Water Application Efficiency

	Net irrigation requirement		Gross application requirement		Net peak period use rate (1" application)		System capacity		
	5/10[a]	8/10[b]	5/10	8/10	5/10	8/10	5/10	8/10	peak period
	(inches/mo.)		(inches/day)		(inches/day)		(gal/min./acre)		
April.....	1.73	1.98	0.10	0.12	0.09	0.10	2.0	2.5	2.6
May.......	4.03	4.44	0.16	0.18	0.15	0.17	3.1	3.7	4.4
June......	5.66	6.24	0.24	0.26	0.23	0.25	4.7	5.3	6.4
July......	7.73	8.19	0.32	9.34	0.32	0.34	6.6	7.0	8.7
August....	6.29	6.80	0.26	0.28	0.25	0.27	5.3	5.8	6.9
September.	3.43	3.93	0.14	0.15	0.15	0.17	2.9	3.1	4.4
October...	0.95	1.21	0.05	0.06	0.05	0.06	1.1	1.2	1.7
Annual....	29.82	32.97	37.41	41.20					

a/ Adequate, 5 years out of 10.

b/ Adequate, 8 years out of 10.

Table III-6. Forage Production Irrigation Requirement, Case 2. Pendleton-Heppner Climate, 70 Percent Water Application Efficiency

	Net irrigation requirement		Gross application requirement		Net peak period use rate (3" application)		System capacity		
	5/10[a]	8/10[b]	5/10	8/10	5/10	8/10	5/10	8/10	peak period
	(inches/mo.)		(inches/day)		(inches/day)		(gal/min./acre)		
April.....	0.90	1.09	0.08	0.09	0.06	0.07	1.7	1.9	2.1
May.......	2.61	2.98	0.13	0.15	0.12	0.16	2.7	3.1	4.7
June......	4.17	4.59	0.20	0.22	0.16	0.18	4.2	4.6	5.3
July......	6.74	7.15	0.32	0.35	0.25	0.27	6.6	7.2	7.9
August....	6.20	6.69	0.30	0.32	0.23	0.26	6.3	6.7	7.6
September.	2.94	3.36	0.15	0.17	0.16	0.17	3.2	3.6	5.0
October...	0.67	0.77	0.03	0.04	0.04	0.05	0.6	0.9	1.5
Annual....	24.23	26.63	35.50	38.30					

a/ Adequate, 5 years out of 10.

b/ Adequate, 8 years out of 10.

8-inch diameter. Drilled and lined at $1.50 per inch diameter per foot depth...................... $15,600

2. Pumps, (a) 100 BHP lift pump to lift 1,000 gpm 300 feet, at 75 percent pumping plant efficiency, with accessories.................................. $10,500

   (b) 60 BHP horizontal centrifugal pressurizing pump for 1,000 gpm to 60 psi, at 75 percent efficiency, with accessories.......................... $ 4,300

3. Mainline, 4,000 feet of 8-inch aluminum with valves at 60-foot spacing, at $2.20 per foot....... $ 8,800

4. Sprinkler systems; four 1,320-foot side-roll systems, each comprised of 33-40-foot sections, and wheels sized for 60-foot moves. Equipped with 13/64 nozzles and self-erecting heads............. $12,000

Irrigation Program

Establishment Schedule

The water supply and system are based on irrigation requirements for July. They far exceed the requirements for the same acreage during the other 9 to 10 months when it is possible to irrigate. On the basis of the premise that capital investment for irrigation is greater than the price of land, it is postulated that an economic procedure for forage production is in conjunction with partial, off-peak-season irrigation of an additional acreage. For this study, the additional acreage was taken to be the same size as the forage field, 130 acres for Case 1 (center-pivot) or 116 acres for Case 2 (4 side-rolls).

It is assumed that the two parcels of land will be contiguous, with the well so located as to require a minimum of mainline. In the case of center-pivot, the well would be between the two pivot points. In Case 2, side-rolls on silt loam, the block of land, 232 acres, would be a rectangle 3,840 feet long by 2,640 feet wide, with the 4,000 feet of mainline running down the center lengthwise. The well and pump are located at the midpoint of the mainline.

Use of the non-forage field could be for cropping, in which the major growth and water use would be during the fall and early spring. Examples of such crops include winter feed grains, peas, or early season hay with a summer dormant season.

It is assumed that the crop will be established where a previous crop has depleted stored moisture. Since the crop should be planted into moist soil, a preplant irrigation will be needed. Sufficient water must be supplied to sustain growth of the new seeding through the establishment season. Accounting for probable consumptive use based on an increasing ground cover, and taking into account the difference in soil moisture storage capacities, it is estimated that 7 inches of irrigation should suffice for the establishment year.

Case 1. Under the center-pivot system, each circle would receive 4 days at 0.4 in./day of preplant irrigation. Subsequent to emergence, each circle would receive, on the average, four additional irrigations during the time interval from approximately August 15 to October 1. This schedule would require moving the system 10 times. From evidence currently available, it appears this would require 60 hours of labor from 2 men, and 60 hours of tractor time.

The establishment irrigation sequence would require an estimated 1,820 acre-inches of water. Pumping this quantity will utilize 69,000 Kwh of energy.

Case 2. For the establishment of 116 acres of forage and a complementary 116 acres of "part season" irrigation using 4 side-roll systems, the following routine was judged appropriate.

Irrigation of the 232 acres would start in July; 23-hour sets would be used, allowing one hour per day for moving each lateral. At a proposed application rate of 0.32 inches per hour, this irrigation would apply 7.4 inches of water which, in the average year, would be sufficient to maintain seedling growth to the end of the first season. Irrigating the 232 acres twice, using 11-hour sets, would be an alternative requiring an additional 128 hours of labor. Irrigating the forage production half twice, and the remaining half once, would be a third option which would require 64 hours of labor in addition to that proposed for the model scheme.

Each of the above alternatives would require pumping 53 acre-inches per day for 32 days, or a total of 1,720 acre-inches. It is estimated that for Case 2, the electric energy required for pasture establishment would be 87,000 Kwh.

Production Year Schedule

Case 1. According to the irrigation requirements shown in Table III-5, 280 acre-inches of irrigation would be required by the 130 acres for forage during the average month of April. This is only 18 percent of the pump and well capacity. If the circle is moved, and 260 acres are irrigated, the pump would run about 36 percent of the time, or 10 to 11 days. Since the average consumptive use rate in April is only about 0.07 inches per day, increasing as the month passes, the best procedure is to irrigate by pan evaporation. For this study, it was assumed each circle would receive 2 irrigations. This would require that the system be moved from one circle to the other 4 times during April.

Average consumptive use is appreciably greater in May, and the system will have to be moved more frequently. Estimated system moves (one direction) for the season are shown in Table III-7.

Table III-7. Center-Pivot System Moves. (130 Acres Full Irrigation Plus 130 Acre Partial.) Allowable Depletion in Circle = 150 Acre-Inches. Pumping Capacity = 50 Acre-Inches Per Day

	System moving schedule		
	On-time	Moves	Time required for moves
April.............	36 percent	4	24 hours
May...............	84 percent	8	48 hours
June..............	100 percent	4	24 hours
July..............	77 percent	none	--
August............	95 percent	4	24 hours
September.........	38 percent	4	24 hours

Table III-8 shows possible allocation of water and system use on a month-by-month basis for two possible schemes for Case 1. On the left hand side, 5 columns show some projections on irrigation if the system is not moved; only one circle is irrigated. In January, February, and March, no pumping occurs (n, in column headed "Program, % time"), because sufficient rainfall (r, in column headed "Status") will occur to provide reasonable certainty that the soil's capacity for available water will be full (F, in colum headed "Status") by the end of March. Irrigation starts in April, with pumping 18 percent of the time to replace the 286 acre-inches of water used or lost and, again, the month ends with the soil reservoir full.

The July requirement for an average year is met on one circle with the 1,000 gpm supply. In September and October, water use can be allowed to slightly exceed pumping, with the expectation that winter rains will be sufficient to refill the profile by the end of March.

The 5 columns on the right of Table III-8 show the same projected statistics for the full irrigation of 130 acres plus the partial irrigation of an additional circle. The water deficits shown in the "Status" column for June and July are allowed to develop in the auxiliary circle by concentrating the use of the system and water on the forage irrigation. Note that this combination allows an additional 50 days' use of the well and system.

In June, a major concern is keeping the forage circle adequately irrigated. The other circle is allowed to dry and go dormant. As noted in Table III-8, right hand side, soil moisture recharge commences in August on the second circle for possible fall hay or forage production, or in preparation for a winter crop. Cover must be sustained or established to control wind erosion.

Table III-8. Estimates of the Pumping Time and Soil Moisture Status for Irrigation of a 130-Acre Circle Irrigated Forage, Either Alone (Scheme 1) or in Conjunction with a Second Partially Irrigated Circle. Case 1, Center-Pivot on Sands [a]

	130 acres only					130 acres full and 130 acres partial				
	Program (% time)	Water pumped	Used or lost	Stored	Status	Program (% time)	Water pumped	Used or lost	Stored	Status
January.....	n[a]				r[c]	n[b]				r[b]
February....	n				r	n				r
March.......	n				F[d]	n				F[d]
April.......	18%	286	286	--	F	36%	572	572	--	F
May.........	42%	663	663	--	F	84%	1,326	1,326	--	F
June........	58%	923	923	--	F	100%	1,600	1,846	-246	-246
July........	87%	1,261	1,261	--	F	100%	1,650	1,950	-300	-546
August......	63%	1,027	1,027	--	F	95%	1,550	1,027	523	- 23
September...	29%	460	560	-100	-100	38%	600	800	-200	-223
October.....	n		169	-169	-269	n		338	-338	-561
November....	n				r	n				r
December....	n				r	n				r
TOTAL.......	88 days	4,620	4,889			138 days	7,298	7,859		

a/ Except "Program, % of time" columns, all other values are in acre-inches of water.
b/ n under "Program, % time" heading means no pumping is planned in the so-designated months.
c/ r under "Status" means rain is expected, which can add to moisture reserves.
d/ F under "Status" means the soil reservoir is full at the end of the so-designated months.

Case 2. For irrigation scheduling in Case 2, considering soil moisture storage capacity, infiltration rate, and consumptive use, it was deemed appropriate to establish an 8-day irrigation rotation. Probably, during some of the 8-day periods some years, the crop will suffer a moisture stress. This was taken to represent a reasonable compromise between capital cost and full production. Example irrigation intervals are reported in Table B-4 of Appendix B.

An estimate of water use and irrigation for 116 acres only, and for a combination 116 acres of forage plus a similar acreage of short irrigation season crop is shown in Table III-9. Pumping would start in April, running 10 percent of the time for 116 acres, or 20 percent for 232 acres to meet the average April requirements and finish the month with the soil filled (F) to capacity. Note that in July a moisture deficit of 350 acre-inches (-350 in "Status" column) develops after the second field is abandoned to meet the irrigation requirements of the forage area.

Irrigations should start early enough so that no more than 2.5 inches of consumptive use occurs before the first full irrigation is completed. Each 11-hour set of each system will irrigate 1.82 acres with a gross application of 3.5 inches, or a net application of 2.5 inches. Using 11-hour sets for the first irrigation will be wasteful, since this irrigation must start before 2.5 inches of storage capacity are available. Five- to 6-hour sets initially would make better utilization of water and pumping energy, but would increase the labor cost.

With an average consumptive use of 0.06 to 0.07 inches per day in late March and early April, a 16-day cycle of 11-hour sets (once through and back to start at 2 x 4 x 1.82 = 14.5 acres/day) could start after a depletion of approximately 1 inch, and finish prior to any stress on the plants. Use of an evaporation pan is essential for accurately establishing the irrigation starting date. This will vary from year to year, depending on the weather.

In May, two 16-day cycles could be completed to satisfy the requirement on the full 232 acres. However, in May or June, consumptive use on the forage becomes so great that the second 116-acre block will have to be allowed to go dormant. Recharge of this area may commence in August or September, as shown by the +350 acre-inches in the "Stored" column of the right half of Table III-9. In May or June, when the second block is dropped from the irrigation schedule, the cycle becomes an 8-day cycle of 11-hour sets. This shift will require a change in the pasturing rotation, to synchronize irrigation and pasture rotations to avoid having livestock on wet land. At least two days of drainage and drying should follow an irrigation before livestock are permitted to graze the block.

Analysis of cost of irrigation, as described above, requires an estimate of the labor requirement. This is compiled for Case 2 in Table III-10 on the basis of 11-hour sets requiring two moves per day.

Table III-9. Estimates of Pumping Time and Soil Moisture Status for Irrigation of 116 Acres of Forage, either Alone (Scheme 1) or in Conjunction with a Second Partially Irrigated Contiguous Field. Case 2, Side-Rolls on Silt Loam a/

	Acre-inches for 116 acres only (Scheme 1)					Acre-inches for 116 acres full and 116 acres partial (Scheme 2)				
	Program (% time)	Water pumped	Used or lost	Stored	Status	Program (% time)	Water pumped	Used or lost	Stored	Status
January......	n b/				r c/	n b/				r c/
February.....	n				r	n				r
March........	n				F d/	n				F d/
April........	10%	160	150	--	F	20%	300	300	--	F
May..........	26%	430	430	--	F	52%	860	860	--	F
June.........	44%	700	700	--	F	88%	1,400	1,400	--	F
July.........	70%	1,120	1,120	--	F	100%	1,650	2,000	-350	-350
August.......	65%	1,040	1,040	--	F	88%	1,390	1,040	+350	F
September....	16%	260	490	-230	-230	20%	340	800	-460	-460
October......	n		120	-120	-350	n		230	-230	-690
November.....	n				r	n				r
December.....	n				r	n				r
TOTAL........	70 days	3,710	4,050			118 days	5,940	6,630		

a/ Except "Program, % time" columns, all other values are in acre-inches of water.

b/ n under "Program, % time" means no pumping is planned for the so-designated months.

c/ r under "Status" means rainfall is expected which will add to moisture reserves.

d/ F under "Status" means the soil moisture reservoir is full at the end of the so-designated months.

Comparison of the estimated pump operation times for the two schemes (116 acres full versus 116 full plus 116 partial) shows that the partial irrigation of the second 116 acres requires an additional 48 days of power consumption, system use, and irrigation labor. Numerous unanswered questions arise with respect to the most profitable use of these inputs. Most of these questions are concerned with the value of livestock feeds.

Table III-10. Labor Time Required for System Moving for Case 2, Side-Rolls on Silt Loam

	Number of sets (11-hour) per system	Days
April....................	12	6
May......................	34	17
June.....................	56	28
July.....................	62	31
August...................	56	28
September................	12	6
TOTAL....................	232	116

232 x 4 = 928 moves

Energy Requirements: Production Year

On the basis of the predicted irrigation requirements as outlined, it is possible to calculate a calendar of energy consumption. A 75 percent pumping plant efficiency was assumed for these calculations.

Case 1. Energy requirements for each pumping month are shown for Case 1, with and without a second circle, in Table III-11. The results shown indicate the energy requirement to be 39 Kwh per acre-inch of water pumped.

Case 2. The energy demand schedule during an average season for the model used for Case 2 is shown in Table III-12. The first two columns of figures are for the scheme of irrigating 116 acres, whereas the third and fourth columns apply to the scheme in which 116 acres of forage would be fully irrigated and an additional 116 acres would receive partial irrigation, depending on availability of water and systems.

Table III-11. Projected Amounts of Energy (Kwh) Required for Pumping Irrigation Water Needed for a 130-Acre Circle of Forage Only, and a Combination of 130 Acres of Fully Irrigated Forage Plus 130 Acres of Partial, Off-Season Irrigation

	130 acres		260 acres, short	
	acre-in.	Kwh	acre-in.	Kwh
April..............	290	10,700	580	21,400
May................	660	26,400	1,320	52,800
June...............	920	34,000	1,600	59,200
July...............	1,260	46,800	1,650	61,100
August.............	1,000	37,000	1,550	57,500
September..........	460	17,000	600	22,200
TOTAL Kwh..........		171,900		274,200

Table III-12. Energy Demand Schedule for Side-Rolls on Silt Loam, Case 2 (Pendleton-Heppner Area)

	116 acres		232 acres, short	
	acre-in.	Kwh	acre-in.	Kwh
April..............	160	8,000	300	15,000
May................	430	21,500	860	43,000
June...............	700	35,000	1,400	70,000
July...............	1,120	56,000	1,650	82,500
August.............	1,040	52,000	1,390	69,500
September..........	260	13,000	340	17,000
TOTAL Kwh..........		185,500		297,000

IV. FORAGE PRODUCTION ALTERNATIVES

Harold Youngberg and Norman Goetze

Successful forage crop production is dependent upon obtaining a good stand of adapted species and using good management practices to attain maximum production. Careful attention must be given each management phase, to assure pastures with high livestock carrying capacity that will compete with cash crop alternatives.

Pasture Establishment

The wind erosion hazard is of primary concern on soils in this area. A soil management program, using cover crops, incorporated organic matter, and irrigating to maintain soil moisture at all times, is essential to reduce soil erosion. Pastures can be established in either the spring or late summer. Spring seedings require much of the growing season to become established, and cannot be grazed until late summer or fall. Harvesting an early crop and seeding the pasture in August can save part of a growing season, as the pasture can be grazed the following spring.

Suggested Schedule for Pasture Seeding

Silt Loam Soil:

Soil test
Apply fertilizer
Disc and prepare seedbed
Drill 1/4 inch deep

Sandy Soil:

Soil test
Apply fertilizer
Drill into stubble
Irrigate to maintain soil moisture

Species and Variety Selection

Several species and varieties of forage crops are available for use under these conditions.

Orchardgrass (*Dactylis glomerata*) is a palatable, long-lived, high producing bunchgrass which is suited for hay, pasture, or silage. The seed germinates rapidly and produces vigorous seedlings. This species does well in mixtures with alfalfa and some clovers. Available varieties are classified as early and late season in maturity. The late season varieties are preferred in mixtures with alfalfa when they are to be harvested for hay. Mid and late season varieties are preferred for pasture production.

Classification of Some Orchardgrass Varieties

Variety	Season of Maturity	Comments
Boone	Early	
"Common"	Early	Not recommended
Chinook	Early	Winter hardy
Potomac	Early	
Masshardy	Mid	
Napier		Winter hardy, drought resistant
Pennmead	Mid	
Sterling	Mid	
Latar	Late	Vigorous, productive
Pennlate	Late	Vigorous, good recovery

Tall fescue (*Festuca arundinacea*), a long-lived bunchgrass well suited for use under a wide range of soil and climatic conditions, is one of the most productive and persistent grasses for use under irrigated pasture conditions in this area. Because it is not as palatable as some other grass species, it must be managed carefully for maximum utilization.

The Alta and Fawn varieties are adapted to these conditions. Fawn is an improved variety having a longer growing season than Alta, and is more palatable to livestock.

Alfalfa (*Medicago sativa*) is a perennial deep-rooted legume well suited for hay production. Its inclusion in a pasture mixture will increase the feed value. If alfalfa represents a major part of the pasture, practices must be used to control bloat. Alfalfa has been seeded at 1 to 2 pounds per acre in a mixed stand with grasses without causing a bloat problem.

Creeping types of alfalfa usually survive better under conditions of continuous, close grazing. Varieties of creeping alfalfa include Nomad, Rhizoma, and Rambler. The Rambler variety has better resistance to bacterial wilt and, therefore, would be expected to survive longer in a planting in this area than the other two varieties.

Standard alfalfa varieties may be more productive than the creeping types, but may require better pasture management to keep them in the stand. Many public and privately developed varieties have been successfully grown in the area, and could be considered. These include Lahontan, Vernal, Washoe, and others. The wilt-resistant Flemish type alfalfas may be very productive in alfalfa-grass pastures with good management. Varieties of this type include Saranac, Anchor, Apex, and Thor. Trial plantings of alfalfa varieties of this type should be considered.

Alfalfa seed <u>must</u> be inoculated with the correct strain of rhizobia immediately before planting. Instructions are available from the county extension office.

White clover (*Trifolium repens*), a long-lived, low-growing legume primarily suited for pasture, requires medium to high fertility for maximum production. It will survive and increase under conditions of close grazing when provided with good fertility. It may present a bloat hazard when it represents a large proportion of the pasture.

New Zealand white clover is an intermediate type in terms of leaf size and height, and is available as a named variety. Common white clover is also of intermediate type, but its characteristics vary according to the region of seed production. It is not recommended unless the seed source is known.

Suggested Seeding Rates for Drilling in Good Seedbed*

Crop	Pounds per acre
Alfalfa in combination with grass...........	1 - 2
White clover in combination with grass......	1
Tall fescue................................	12 - 15
Orchardgrass...............................	11 - 14

*Rates increased 50 percent when broadcast.

Pasture Management

Two common methods of using pastures are: (1) Continuous grazing, where pastures are stocked at a given rate and the livestock graze the same field all season, and (2) rotational grazing, where a short grazing period is followed by a comparatively long rest period. The lengths of the rest period depend upon the pasture species and the rate of pasture regrowth. The rate of regrowth will vary with the season, being slower in midsummer than in spring or fall.

The objective of good grazing management is to attain the greatest net return and at the same time maintain a vigorous and nutritious pasture. Intensive utilization, which is made possible by a good rotational grazing program, is usually less harmful to the forage plants than continuous grazing. Published results for conditions similar to this area have shown greater animal gains per acre on rotationally grazed pastures than on continuously grazed pastures.

A good management system should be flexible in order to use all the forage as pasture, hay, or silage. If the forage cannot be used for hay or silage, it should be clipped to prevent the plants from forming seed and to promote more rapid vegetative regrowth.

Grazing should start when the plants are 8-10 inches high, and grazed until a 3-4 inch stubble remains. A 20-30 day regrowth period should be allowed. Clipping may be necessary to prevent patchy grazing, to control weeds, and remove seed heads.

Adjustment in the area to be grazed and the frequency of rotation may be necessary according to the rate of regrowth. Regrowth rates will be most rapid in the spring, and slower during the summer months.

Stage of pasture growth is the most important factor influencing feed value and chemical composition of the pasture. If the pasture plants are permitted to reach an advanced stage of maturity, the plants develop a high percentage of crude fiber which decreases both palatability and digestibility.

A balanced pasture rotation program must allow for greater livestock numbers during peak pasture production periods or for harvesting forage from some pastures during that period for hay or silage.

Fertilization

Intensively managed high-producing irrigated pastures require large amounts of nutrients, some of which may not be limiting on virgin soil. Soil tests are the best guide for documenting changes in the nutrient status of the pastures.

Nitrogen (N)

1. If pasture has a good legume stand, to stimulate fall and spring grass growth, apply 30 to 40 pounds N per acre in both fall and spring.

2. If pasture is predominantly grass, with only some legume:

   a. Medium to fine textured soil

      Apply three 100 pounds of N/acre applications (one each in spring, summer, and fall) for a seasonal total of 300 pounds N/acre.

   b. Coarse textured soil

      Apply six 50 pounds of N/acre applications from spring to fall for a seasonal total of 300 pounds N/acre.

3. If pasture is a pure stand of grass, increase rates in (2) by 50 percent.

Phosphorus (P)

OSU soil test for P (ppm)	Apply (lbs/acre) P_2O_5	or P
0 - 10	80 - 100	35 - 44
10 - 15	60 - 80	26 - 35
Over 15	0	0

Potassium (K)

OSU soil test for K (ppm)	Apply (lbs/acre) K_2O	or K
0 - 100	80 - 100	66 - 83
100 - 200	60 - 80	50 - 66
Over 200	0	0

Sulfur (S)

High yielding pastures require constant supplies of sulfur. Soil tests for sulfur are unreliable. Sulfur rates of from 20 to 30 pounds per year are required. Sulfur may be supplied in other mixed fertilizers, and may be applied any time in the season.

Boron (B)

If OSU soil test for B is below 0.5 ppm, apply 2 pounds of B per acre. None should be used if test levels are above 0.5 ppm. On some sites, excessive soil or water boron contents may be limiting production. Further research is needed on correcting such excesses.

Fertilizing During Pasture Establishment

All of the required phosphorus, potassium, sulfur, and boron can be broadcast and incorporated during final seedbed preparation. Boron should not be banded or concentrated near seedlings. If a legume is being seeded, limit nitrogen applications to seedbed to 40 lbs/acre. This rate can be doubled on pure grass stands if mixed to a depth of three inches or more.

V. ESTIMATED COSTS OF FORAGE PRODUCTION

Gene Nelson

This section outlines a method of economic analysis. This format might be used as a guide by farmers and ranchers in estimating production costs for irrigated pasture. The two cases used are not intended to represent average or typical situations.

Irrigated pasture production in the Oregon Columbia Plateau counties is a relatively new enterprise. Hence, the data upon which this analysis is based cannot be documented by experience.

Pasture enterprises differ due to varying resource prices, physical resources used, land quality, life of stand, etc. The farmer or rancher should study this analysis and then evaluate his own enterprise. He can add to, change, or delete cost data as needed to portray his own situation.

The results of the cost analysis for irrigated forage are presented for the two case situations, Case 1, "center-pivot on sandy soil", and Case 2, "side-roll on silt loam". The purpose here is to present the underlying assumptions, and explain the procedures used in developing these costs.

Establishment Costs

In both cases it is assumed that the pasture is established in the fall after the harvest of irrigated grain. While the cultural operations presented represent a reasonable sequence, there will be a great deal of variation depending upon erosion problems, soil type, water availability, previous cropping, etc. The total cost per acre for establishment in this analysis was found to range from $66.79 for the center-pivot on sandy soil to $61.18 for the side-roll on silt loam (Tables V-13 and V-14).

To prorate this establishment cost over the assumed 8-year life of the stand, it was amortized at 7 percent for the 8 years. This results in an annual cost of $11.19 for the center-pivot on sandy soil, and $10.25 for the side-roll on silt loam. This annual amortized establishment cost can be thought of as equivalent to depreciation and interest on the establishment investment.

Irrigation Costs

The total initial capital investment for irrigating the two soil types is as follows:

	Center-pivot on sandy soil	Side-roll on silt loam
Sprinkler system.........	$19,000	$12,000
Mainline.................	9,450	8,800
Pumps....................	10,700	14,800
Well.....................	3,200	15,600
TOTAL INVESTMENT.........	$42,350	$51,200

Table V-13. Establishment Cost Per Acre of Irrigated Pasture, Case 1, Center-Pivot System on Sandy Soil, 130 Acres

	Labor[a]		Mach. & equipment[b]	Other		Total cost
	Hrs.	Value		Item	Value	
		($)	($)		($)	($)
Cultural operations						
Fertilize............	0.30	0.90	1.40	N	4.00	6.30
Disc..................	0.20	0.60	1.15			1.75
Irrigate (8.0 in. gross)............	0.32	0.96	6.48	power	2.26	9.70
Move system..........	0.46	1.38	0.46			1.84
Seed (Aug. 15 to Sept. 1)..........	custom-aerial		4.00	24# seed	18.00	22.00
Pack..................	0.15	0.45	0.90			1.35
Fertilize............	0.30	0.90	1.40	P-K	14.00	16.30
Spray weeds..........	custom		1.00	chem.	1.00	2.00
Other charges						
Land charge (4 mo.)...					3.30	3.30
Operating capital interest (7 percent)					1.00	1.00
General overhead......					1.25	1.25
TOTAL COST PER ACRE.....		5.19	16.79		44.81	66.79
AMORTIZED ESTABLISHMENT COST PER YEAR (7 percent for 8 years)...............						11.19

a/ Labor is valued at $3.00 per hour.

b/ A 70-HP wheel tractor is assumed at a $4.00 cost per hour.

Table V-14. Establishment Cost Per Acre of Irrigated Pasture, Case 2, Side-Roll System on Silt Loam, 116 Acres

	Labor[a]		Mach. & equipment[b]	Other		Total cost
	Hrs.	Value		Item	Value	
		($)	($)		($)	($)
Cultural operations						
Fertilize............	0.30	0.90	1.40	N	4.00	6.30
Disc and pack.........	0.20	0.60	1.25			1.85
Springtooth (2x)......	0.25	0.75	1.65			2.40
Seed..................	0.25	0.75	2.00	16# seed	12.00	14.75
Irrigate (7.4 in. gross).............	0.60	1.20	8.14	power	3.14	12.48
Fertilize............	0.30	0.90	1.40	P-K	14.00	16.30
Spray weeds...........	custom		1.00	chem.	1.00	2.00
Other charges						
Land charge (4 mo.)...					3.30	3.30
Operating capital interest (7 percent).					.80	.80
General overhead......					1.00	1.00
TOTAL COST PER ACRE.....		5.10	16.84		39.24	61.18
AMORTIZED ESTABLISHMENT COST PER YEAR (7 percent for 8 years).............						10.25

a/ Labor is valued at $3.00 per hour.

b/ A 70-HP wheel tractor is assumed at a $4.00 cost per hour.

Based on these initial investments, the average annual ownership costs were figured:

	Center-pivot on sandy soil	Side-roll on silt loam
Depreciation................	$3,246	$3,407
Interest (7 percent)........	1,482	1,792
Repairs.....................	550	560
Property taxes (2 percent)..	424	512
Insurance (0.5 percent).....	212	256
TOTAL OWNERSHIP COST........	$5,914	$6,527

The depreciation calculations were based on a 10-year life for the sprinkler system, 20-year life for the mainline and well, and 15-year life for the pumps. Interest was figured on the average investment at 7 percent.

With water-pumping rates at 7,300 acre-inches for the center-pivot and 5,940 acre-inches for the side-roll, the ownership costs per acre-inch of water pumped would be $0.81 for the center-pivot and $1.10 for the side-roll. This assumes that, in addition to the pasture, the irrigation system is used to partially irrigate an equal acreage of grain.

The labor requirement for the center-pivot on sandy soil is based on a 138-day irrigation program, assuming two hours labor per day, which amounts to about 0.04 hours per acre-inch pumped. In addition, labor is required for 24 pivot-to-pivot moves requiring 12 man-hours and 3 tractor-hours each.

Labor requirements for the side-roll system on silt loam involves a total irrigation program of 928 lateral moves at one-half hour of labor per move. This represents about 0.08 hours per acre-inch. An additional labor requirement was added for lowering and raising the fencing to allow the system to move from one pasture to the next.

The power costs are based on pumping 7,300 acre-inches through the center-pivot system and 5,940 through the side-roll. The annual pumping energy costs are estimated at $2,064 and $2,525, respectively. The cost per acre-inch then is 28.2 cents for the center-pivot and 42.5 cents for the side-roll.

Fencing Costs

Case 1, the center-pivot system on sandy soil, will require 1.6 miles of fencing around the circumference, plus 2 miles of fence with gates to allow the irrigation system to pass through, dividing the circle into 8 pastures. The total investment is assumed to be $4,542, or $34.94 per acre. Depreciation over 15 years, interest at 7 percent, taxes, and repairs would amount to $5.07 per acre.

Case 2, "side-roll on silt loam", requires 2.8 miles of fence for lanes and boundary, and 2 miles of movable electric fence. The total assumed investment for fencing is $2,132, or $18.37 per acre. The annual cost for depreciation, interest, taxes, and repairs would be $2.54 per acre.

Forage Production Costs

Considering that the two cases, "center-pivot on sandy soil" and "side-roll on silt loam", represent quite different situations, it is surprising that the total costs per acre of forage production are nearly the same (Tables V-15 and V-16). Both are between $125 and $126 per acre. This is certainly not to be expected generally. Each farmer or rancher should make his own cost analysis, based on his particular situation.

The key factor in interpreting these per-acre cost figures is the level of production to be achieved. If the cost of forage is $126 per acre, the costs per A.U.M. would be as follows for the various production levels:

A.U.M.'s per acre	Cost per A.U.M.
16	$7.88
18	7.00
20	6.30

The production might be measured alternatively as the weight gain of the grazing livestock. With the $126 cost of forage, the cost per pound of gain would be as follows:

Pounds of gain per acre	Cost per pound
800	15.8¢
1,000	12.6¢
1,200	10.5¢

Further research is required to obtain better estimates as to what levels of irrigated forage production can be achieved under high levels of management in the Oregon Columbia Plateau counties.

Effect of Spreading Irrigation Use

It has been assumed in this analysis that each irrigation system, in addition to its use on pasture, is used to irrigate an equal acreage of grain. Using the irrigation system to irrigate grain before and after the peak requirement period for the pasture would appear to be a feasible alternative in many cases. However, if this is not possible, the result would be increased costs for pasture production.

The costs presented below represent all the labor, machinery, equipment, and power costs for irrigating one acre of pasture if the system is used on the pasture only, compared to irrigating both pasture and grain.

	Center-pivot on sandy soil	Side-roll on silt loam
Pasture only............	$63.81	$84.28
Pasture plus grain.......	48.57	57.20
DIFFERENCE PER ACRE......	$15.24	$27.08

Table V-15. Forage Cost Per Acre of Irrigated Pasture, Case 1, Center-Pivot System on Sandy Soil, 130 Acres

	Labor[a/]		Mach. & equipment[b/]	Other		Total cost
	Hrs.	Value		Item	Value	
		($)	($)		($)	($)
Cultural operations						
Fertilize (4x)........	1.2	3.60	5.60	N-P-K	22.00	31.20
Irrigate (35.5 in. gross).............	1.4	4.20	28.76[c/]	power	10.01	42.97
Move system...........	1.4	4.20	1.40			5.60
Clip (4x).............	1.2	3.60	6.00			9.60
Drag (6x).............	0.9	2.70	3.80			6.50
Other charges						
Amortized establishment cost..........					11.19	11.19
Fence - depreciation, interest, repair...					5.07	5.07
Land - interest @ 7 percent, and taxes.					10.00	10.00
Operating capital interest (7 percent).					1.05	1.05
General overhead......					2.00	2.00
TOTAL COST PER ACRE.....		18.30	45.56		61.32	125.18

a/ Labor is valued at $3.00 per hour.

b/ A 70-HP wheel tractor is assumed at a $4.00 cost per hour.

c/ Another 130 acres is partially irrigated.

Table V-16. Forage Cost Per Acre of Irrigated Pasture, Case 2, Side-Roll System on Silt Loam

	Labor[a/]		Mach. & equipment[b/]	Other		Total cost
	Hrs.	Value		Item	Value	
		($)	($)		($)	($)
Cultural operations						
Fertilize (2x).........	0.6	1.80	2.80	N-P-K	22.00	26.60
Irrigate (32.0 in. gross)..............	2.8	8.40	35.20[c/]	power	13.60	57.20
Clip (4x)..............	1.2	3.60	6.00			9.60
Drag (6x)..............	0.9	2.70	3.80			6.50
Other charges						
Amortized establishment cost...........					10.25	10.25
Fence - depreciation, interest, repair....					2.54	2.54
Land - interest @ 7 percent, and taxes..					10.00	10.00
Operating capital interest (7 percent)..					1.20	1.20
General overhead.......					2.00	2.00
TOTAL COST PER ACRE......		16.50	47.80		61.59	125.89

a/ Labor is valued at $3.00 per hour.

b/ A 70-HP wheel tractor is assumed at a $4.00 cost per hour.

c/ Another 116 acres is partially irrigated.

Spreading the use of irrigation equipment has an important effect on the cost allocated to the pasture enterprise. However, the amount of increase differs between the two models. If the center-pivot system is used on the pasture only, the costs per acre for forage production are calculated to increase by $15 per acre, i.e., from $125 to $140. The costs for the side-roll system would increase by $27, or from $126 to $153, if the irrigation system is used only on pasture. The smaller increase in cost for the center-pivot system is partially due to the savings in moving costs.

VI. LIVESTOCK PRODUCTION ALTERNATIVES

John H. Landers, Jr.

Some of the alternatives are:

1. *Cows and calves*
   a. Fall or spring calving

2. Wintering weaner *steers* and grazing through the summer
   a. Selling off grass for finishing
   b. Finishing on grass with supplemental grain

3. Wintering weaner *heifers*
   a. Grazing during the following summer
      (1) Selling to the feedlot
      (2) Summering and breeding
      (3) Selling as springers

4. Raising *dairy heifers* on contract with dairymen

5. *Sheep* production
   a. Feeder lambs with cattle or ahead of cattle

Cows and Calves

For consideration, it is assumed that fall calves are born in October and November, winter calves in January and February, and spring calves in March and April.

The alternative of fall calving should be seriously considered. Some possible advantages are: calves could better utilize spring-grown forage, heavier weaning weights, fewer disease problems, and sale at the time of limited supply of feeder cattle. An important disadvantage would be a higher wintering cost for the cow that is producing milk. In all probability, these calves could use some creep feed during the winter and provide a good return on the money invested in creep feed.

Artificial insemination of the fall calving cows may be seriously considered, as these cows will probably be in dry lot, or in very close confinement, and may be checked rather easily for heat. Chemicals for controlling the estrus of cows are expected to be available in the near future.

Late winter and spring calving does reduce, to a degree, the winter feed costs of the mother cows. They are apt to wean lighter weight calves than those cows that calve in the fall.

As soon as the calves are weaned, these dry cows can be put on wheat or barley stubble and carried nearly to the time they will drop calves. It may be necessary to feed these cows some supplemental hay immediately prior to calving. This should help insure a reasonably good supply of milk. If these dry cows are carried on good grass, they will become overly fat. This may cause some complications in giving birth to the calf, or a cow will occasionally not milk or rebreed as she should. Supplementary vitamin A probably will not be necessary, since these cows would be off green grass for only 3 months.

Steers

If weaner calves are purchased in the fall and carried through the winter, they should be obtained before the first of the year, as the supply is generally lower in early winter. There are some operators that hold calves until after the first of the year for tax purposes. By purchasing calves in the fall, it does give you an opportunity to buy at a lower price because of the larger supply. These steer calves should be carried on a nutritional level to gain at least a pound and a half daily. It may be necessary to supplement locally grown forages with some home-grown grain. These steers could come off the grass around the 15th of July and go directly to a commercial feedlot.

It may be advantageous to own them through the feedlot rather than sell them to a feedlot operator. This is particularly true with cattle that have the ability to grow rapidly, as the rate of gain and efficiency of gain are very highly correlated.

It may be desirable to grain-feed steers on grass the latter part of the summer if gains drop below one and one-half pounds daily. Supplemental grain could go up to 10 pounds a day and materially shorten the length of time that would be necessary in the feedlot. In this instance it is usually more advantageous to own these cattle through the feedlot, as the feedlot operator feels that he can put the gains on cheaper than he can buy it under the present price structure.

It is risky to attempt to sell these cattle straight off the grass for slaughter, as the majority of breeds of cattle will deposit the carotene from the grass into the fat, and the fat will appear yellow. This detracts from the eye appeal, but has no effect from a human nutrition standpoint.

Heifers

It is highly desirable to raise your own replacement heifers if you maintain a breeding herd. The procedure on selecting these heifers will be discussed later.

Among the alternatives for heifers are the sale of replacement heifers and springer heifers. These may be F-1's or F-2's - that is to say, a crossbred heifer or a 3-breed cross heifer - or they may be straightbred cattle.

In selecting replacement heifers, a system that has worked is as follows: Cull out the low half of the heifers at weaning time and sell them. Carry the remainder of these heifers on a nutritional level that will have a winter gain of 1-1/4 to 1-1/2 pounds daily. The idea here is that these heifers should be big enough to breed by the time they are 14 to 15 months of age. The undesirable heifers may be weeded out and sold prior to breeding time.

Pregnancy test the remaining heifers. Select those heifers that are needed for herd replacement by weight and conformation. The remaining heifers may be sold to other growers. Even though they may be considered culls to you, they could be tremendous replacement heifers for some other operator.

If the operator has the time to spend, artificial insemination should definitely be considered when breeding these heifers because, generally, semen is available from bulls that are much more productive than bulls one could afford to own. This is particularly true if you have a small number of heifers to breed.

It goes without saying that the best bull available is none too good for obtaining maximum productivity.

Dairy Heifers

A contractual arrangement with a dairy for raising replacement heifers up to nearly the point of calving may be a good enterprise. This may be handled either on a "per pound gained" basis, or the man with the forage may buy the calves, raise them up to the point of springers, and then sell them. It would appear more feasible to have a contract arrangement. Then you are sure of a home for these heifers when they are ready to move.

Sheep

Sheep may be raised separately or they may be carried in conjunction with cattle, as they will graze together with no complications. From research done at Oregon State University, it would appear that cattle and sheep will eat a completely different type of diet, and are not competitive. This assumes that there is plenty of feed. It would appear that 3 to 5 ewes can be carried per acre on properly managed, highly productive land.

The grazing of feeder lambs also offers an opportunity.

Further Considerations

Parasites

Internal parasites on cattle or sheep may be the great stumbling block in the use of irrigated pastures in the Columbia Basin.

It is advisable to treat all the cattle or sheep as they are brought into the grazing area, and it is further advised that fecal samples be taken on a select group of animals on a monthly basis, to keep check on the control of stomach worms. Veterinarians have the equipment and know-how to do an egg count, which is an excellent measure of the parasite load that an animal carries.

Minerals

Forages and other feeds supply most of the needed mineral elements in sufficient quantities to meet animal needs. Feeds from the northwest section of the country are generally deficient in iodine; however, iodized salt, fed in loose form, will provide sufficient iodine to prevent goiter. Selenium may not be provided in sufficient quantities through the feeds and forages and can only, at present, be supplied by injections. There have been problems of copper and zinc deficiencies and molybdenium toxicity in the Columbia Basin area. Legume forages are traditionally high in calcium, while some grasses are quite low in phosphorus. The calcium-phosphorus ratio should be from 1:1 or 2:1 for optimum production. Ratios between calcium and phosphorus of 7:1 have been reported to be satisfactory for cattle. Phosphorus may be provided to cattle and sheep by supplementing with a source such as sodium-tripolyphosphate. Phosphorus content of plants generally decreases markedly with maturity. Cattle gleaning stubble fields should have a supplementary source of this mineral. Make iodized salt and a source of phosphorus available to cattle and sheep at all times. Trace element requirements vary a great deal between areas. Since the cost of trace mineralized salt varies little from iodized salt, it may be desirable to use iodized trace mineralized salt.

Make the salt available in one section of the mineral box and the phosphorus in another.

Bloat

Research from Utah indicates they can obtain 1,200 to 1,400 pounds of beef per acre on straight alfalfa. Similar data is available from the Prosser, Washington, station. Bloat is a major concern when grazing legumes. Some forms of bloat are inherited. Poloxalene is a compound on the market that will control bloat, provided the cattle are given a constant supply of it. The work in Utah indicates that the proper amount of Poloxalene mixed with a pound of ground grain, given to cattle twice daily, held the incidence of critical bloat to near zero. This is the only material for bloat control currently on the market. Mix the Poloxalene with ground grain at such rate that cattle will consume approximately 2 grams Poloxalene per hundred pounds body weight daily.

Production Records

Without keeping adequate production records on a cow herd you are in trouble, because you do not know from one year to another which of these cows is doing the best job of production.

The essentials in a production testing program are:

1. Identity of a cow and calf.

2. Scales.

3. A weaning weight. The cow can be evaluated from the weaning weight of her calf adjusted to 205 days, corrected for the

age of the cow, if the cow age is known. This also gives a basis for the initial selection of replacement heifers.

4. Weaning conformation score on the calf. An index is obtained by considering the adjusted weaning weight, along with the conformation score of the calf at weaning time.

5. It is desirable to know the sire of the calf.

Cows and calves may be identified in a number of different ways. There are a number of plastic tags on the market that work very well. Freeze branding and hot iron branding are acceptable methods of identity. By all means, tattoo these cows so that, in case all other identity is lost, that tattoo is still there. Formulate your tattoo numbers in such a manner that either the first or the last digit is the year of birth.

Refer to Oregon State University Special Report 315 for instructions on production records.

Carcass Quality

The USDA has available what it calls the "Orange Tag Program". A grower obtains these orange tags and places them in the ears of steers or heifers about which he desires carcass information. Regardless of where these cattle are slaughtered, the carcass data is obtained and will ultimately get back to the original buyer of the tags. The Oregon Cattlemen's Association has obtained a supply of these tags. There is a cost of about $2 per tag to cover the cost of gathering the data and returning it to the owner. You will buy a series of numbered tags, and the numbers are assigned to you. Livestock operators are concerned about the kind of carcass they are producing. These data will provide factual information for the selection of breeding stock.

Crossbreeding

Crossbreeding is very desirable under some conditions, and may be highly undesirable in others. If you have a well-designed, well-followed crossbreeding program, it can be made to work effectively. Generally, crossbred calves will gain more rapidly than straightbred calves, and crossbred cows have a higher level of fertility and produce more milk than straightbred cows. A broader genetic base for crossbreeding has been made possible by the importation of several breeds. One of the secrets of success in a crossbreeding program is to have cows of known productive ability, and use the services of the best bulls available. A.I. may be desirable in a crossbreeding program, particularly with a limited number of cows. One of the drawbacks of a crossbreeding program is that you will probably need to buy replacements if you follow a single-cross program. Unfortunately, we do not know to what length crossbreeding programs can go for cattle. It has been pointed out in the case of sheep that through six or seven different breeds of rams, this crossbred lamb is still growing more rapidly than the straightbred or the preceding cross. Extensive research is currently underway at the Meat Animal Research Center, Clay Center, Nebraska, that should answer these questions for us, but the answers are not available at the present time.

VII. ESTIMATED LIVESTOCK COSTS AND RETURNS

Gene Nelson

In appraising the economic feasibility of irrigated pasture development, careful study must be given to how the forage will be harvested. Will the pasture be rented out, or will the operator graze it with his own stock? How much of the forage will be harvested as hay? Will the livestock be fed a concentrate supplement while grazing?

Two alternative systems of harvesting irrigated pasture are presented. Both involve beef production. The first alternative involves grazing the irrigated pasture with cows and calves. The second utilizes yearling steers to harvest the forage. These represent only two of several alternatives that might be considered. While they are not particularly imaginative, it is felt that they do present some potential.

Again, the reader is cautioned in interpreting the analysis presented here. Differing assumptions regarding cattle prices would affect the results of the analysis. Each individual pasture development proposal represents a unique situation that needs to be studied on its own economic merits.

Grazing with Cows and Calves

The budget in Table VII-17 presents the return to forage for each cow and calf unit fed from the irrigated pasture. According to this budget, each cow and calf unit, including replacements, could profitably pay up to $68.55 per cow for the forage grazed and fed as hay during the winter.

The cow-calf budget assumes calving during February and March, with a 90 percent calf crop at weaning. There is a 1.5 percent death loss of cows, and 51 percent of the heifers are saved back as replacements. The cull stock sold includes both cows and bulls.

Following the pasture grazing season, the cows are grazed on grain stubble for two months. Assuming there is no alternative use for this stubble, no charge is made in the budget. For the remainder of the winter each cow unit requires 20 pounds of hay daily. This hay is assumed to come from the irrigated pasture during periods of excess forage production. A charge for harvesting and stacking this winter feed is included in the budget.

Grazing with Yearling Steers

The budget in Table VII-18 indicates a $52 per head return to forage grazed and fed as hay with this yearling steer enterprise. The steers are assumed to be purchased February 1, weighing 450 pounds per head, and sold November 1 at 870 pounds. The difference between the number purchased and sold accounts for death loss.

During the first 60 days before going to pasture, the steers are expected

Table VII-17. Forage Return from Grazing Irrigated Pasture with a Cow and Calf Unit

Receipts			
Steers	(0.45 hd. @ 550# @ 31¢).............	$76.73	
Heifers	(0.31 hd. @ 520# @ 27¢).............	43.52	
Cull stock	(0.14 hd. @ 1,046# @ 20¢).............	29.30	
			$149.55
Expenses			
Salt and mineral	....	$ 2.00	
Stacking winter feed (1.2 ton @ $5)	....	6.00	
Veterinary and medicine	....	3.00	
Operating capital interest (7 percent)	....	1.50	
Marketing and trucking	....	4.00	
Machinery repairs and fuel	....	1.50	
Buildings, corrals, equipment	....	7.50	
Cattle - interest @ 7 percent, and taxes	....	24.50	
Bull purchase	....	9.00	
Labor (6 hours @ $3)	....	18.00	
Miscellaneous and overhead	....	4.00	
			81.00
RETURN TO FORAGE PER COW	....		$ 68.55

Table VII-18. Forage Return from Grazing Irrigated Pasture with a Yearling Steer Purchased February 1

Receipts			
Steers (1.00 hd. @ 870# @ 27.5¢).................			$239.25
Purchases			
Steers (1.02 hd. @ 450# @ 33.5¢).................		$153.75	
Expenses			
Stacking winter feed (0.4 ton @ $5)......	$ 2.00		
Concentrate supply (350# @ 3¢)...........	10.50		
Salt and mineral.........................	0.50		
Veterinary and medicine..................	1.50		
Operating capital interest (7 percent)...	7.00		
Marketing and trucking...................	6.00		
Labor (1.33/hour @ $3)...................	4.00		
Miscellaneous and overhead...............	2.00		
		33.50	
			187.25
RETURN TO FORAGE PER STEER..			$ 52.00

to gain about 1.1 pounds per day and consume 0.4 ton of hay per head. This hay was made from excess forage production during the previous year. On pasture the steers are expected to gain 1.75 pounds daily. During the last 70 days they are fed a concentrate supplement at a rate averaging 5 pounds per day.

Break-Even Forage Productivity Levels

Due to the lack of information on forage production levels, carrying capacities, etc., little can be concluded generally about the economic feasibility of irrigated pasture production. However, given the cost for forage production and the return to forage from the livestock alternatives, the "break-even" levels of production can be determined. The analysis presented below assumes a forage production cost of $126 per acre.

First, the forage requirement for each livestock alternative must be put on an AUM basis. Assuming a ton of hay is equivalent to 3.5 AUM's, the cow-calf unit will require 4.2 AUM's as hay, plus 9.1 AUM's from grazing, for a total of 13.3 AUM's per unit. On this basis, the cow-calf enterprise would break-even at a forage cost of $5.15 per AUM.

The steers require 1.4 AUM's as hay and 5.3 AUM's from grazing, for a total of 6.7 AUM's per head. The steer enterprise could pay $7.76 per AUM and break even. Dividing $126 by $5.15 and $7.76, the break-even production level for each enterprise can be determined.

	Break-even production
Cows and calves..........	24.5 AUM's/acre
Yearling steers..........	16.2 AUM's/acre

To achieve the break-even production, the acre of irrigated pasture would have to carry 1.8 cow-calf units, including replacements, during the grazing season, and provide 2.2 ton of hay in addition. With the yearling steer enterprise, the stocking rate would be 2.4 head per acre, plus 1 ton of hay.

At the break-even production level, the cow-calf enterprise would be yielding roughly 1,000 pounds of beef per acre. For the yearling steer alternative, the pounds of gain would amount to about 1,000 pounds per acre of forage. However, the concentrate supplement fed also contributes to this beef production.

Stocking Rates Versus Daily Gains

One of the important decisions in the management of a livestock grazing enterprise is the rate at which the pasture is to be stocked. Two relationships need to be taken into consideration. First, as the stocking rate increases, the rate of gain per animal beyond a certain point tends to decrease. On the other hand, as the stocking rate increases, the rate of gain on a per-acre basis increases, reaches a maximum, and then decreases. The maximum gain per acre is achieved at a higher stocking rate than is the maximum gain per animal. The stocking rate yielding the maximum profit will lie somewhere between the two extremes, and depends upon the relative cost of forage and return from livestock production. The following example illustrates the economic considerations.

Assume three rates of daily gain for a yearling steer enterprise beginning April 1. The stocking rates are calculated to yield 1,050 pounds of gain per acre in each case.

Rate of gain	Stocking rate	Return to management
1.50 lbs/day	3.50 hd./acre	$-11.02/acre
1.75 lbs/day	3.00 hd./acre	1.50/acre
2.00 lbs/day	2.63 hd./acre	9.84/acre

With forage cost at $126 per acre, the profit per acre, measured as return to management, is calculated for each situation. At 1.50 pounds daily gain, the steer is assumed to be sold at 820 pounds for 28 cents per pound. For 1.75 pounds daily gain, the selling weight and price are 870 pounds and 27.5 cents. With daily gain at 2 pounds, the figures are 920 pounds and 27 cents.

In this example, no additional costs were added for supplemental feeding which may be required to achieve the higher rates of gain. Whether or not supplemental feeding is required depends on the nutritive content of the forage. Sufficient research has not been completed to determine the interrelationships between stocking rate, daily gain per head, gain per acre, and pasture profits in the Oregon Columbia Plateau counties.

VIII. CONCLUDING REMARKS

From this analysis, it appears there is a role which irrigated forage and livestock production can play as an alternative enterprise in this area. While this enterprise has a high level of gross returns, it also requires a high investment. The two cases presented here represent investments of $100 to $150 thousand in land, equipment, and livestock. Thus, financing and credit considerations, and cash flow requirements, take on critical importance in determining the success of the enterprise.

This report leaves many unanswered questions. For example, more information is needed on the yields of forage production which can be expected in this area, and what management practices are most effective in increasing these yields. Also, alternative systems of livestock production need to be more completely analyzed. Hopefully, cooperative efforts will be organized to provide satisfactory answers to these questions.

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APPENDIX A

IRRIGATION REQUIREMENTS: DEFINITIONS, UNITS, AND CONVERSION FACTORS

1. Computed Average Consumptive Use (C.U.) is the calculated amount of water that a given crop would use during a given month, under the circumstances stipulated below.

   a. There is adequate water available to the crop so that it is free to use as much as is demanded - water supply to the root system is not limiting.

   b. The crop is healthy, thrifty, vigorous, and a full leaf canopy covers the ground.

   c. The crop is using water from the soil reservoir only.

   d. The "climate" for the month is "average" in terms of temperature, sunlight intensity and duration, relative humidity, turbulence, etc.

   e. Average CU (inches/month) is calculated by the modified Blaney-Criddle formula, which correlates well with measurements on a monthly basis, not on a daily or weekly basis.

2. Net irrigation requirement (inches/month) is consumptive use minus the averaged measured rainfall for the corresponding month. Sufficient 5 years out of 10 is the net amount of water which, when added to rainfall, produces an amount equal to the consumptive use which is not likely to be exceeded 5 years out of 10. This amount of consumptive use is likely to be exceeded during the other 5 years out of 10.

   Similarly, the net irrigation requirement - 8/10 - is not likely to be exceeded 8 years out of 10. One can expect it to be exceeded 2 years out of 10.

3. Net peak period use rate is the average daily consumptive use adjusted for the probability that, during a short irrigation interval, the average daily use rate is likely to be quite different from the average daily use rate calculated for a 30-day period (1 month). In irrigation design, high peak period use rates are important. They must be designed for net peak period use rate to have an adequate system.

4. Gross application requirement is calculated from net irrigation requirements by estimating (from research measurements) evaporation losses (it may not be total loss), deep percolation, and runoff losses. Deep percolation may return to ground water or seep out in surface springs. Deep percolation losses from an adequate irrigation are inevitable.

The calculation of gross applications is made by:

$$\frac{100 \text{ net irrigation requirement}}{\text{application efficiency (\%)}}$$

5. Application efficiency is the percentage of applied water which is put into the soil and is utilizable by the growing crop.

6. System capacity (volume per unit time) is the measure of the size of the system required to apply the gross application required after taking into account probable down time. In this report, down time was assumed to be 2 hours per day, or 8 percent.

7. Annual values are the sum of daily or monthly increments for the irrigation season. In this report the irrigation season is defined as the time interval from April 15 to October 10.

8. Pumping efficiency equals:

$$100 \times \frac{\text{lbs. of water lifted} \times \text{total dynamic head in feet}}{\text{input energy in foot lbs.}}$$

   a. Lbs. of water lifted = acre-inches of water pumped x 226,500 lbs. per acre-inch.

   b. Head in feet = lift + 2.25 x desired pressure (psi)

   c. Kwh per acre-inch = 0.12 x head in feet in pumping efficiency is taken as 75 percent.

   d. $$\text{H.P. requirement} = \frac{100 \times \text{gpm} \times \text{total dynamic head}}{3{,}960 \times \text{efficiency}}$$

9. Units

1 acre-inch per hour = 450 gallons per minute (gpm).

450 gpm = 1 cubic foot per second (cfs).

1 gpm = 0.053 acre-inches per day.

1 acre-inch per day = 18.8 gpm/acre.

0.1 acre-inch per day = 1.88 gpm/acre.

1 acre-inch per month (30 days) = 0.63 gpm/acre.

For 1,300 foot (130 acres) center-pivot systems:

1,000 gpm = 0.38 inches per day at 0.08 down time.

1,000 gpm = 0.41 inches per day at zero down time.

0.1 inches per day = approximately 250 gpm.

10. Application rates

$$\text{Inches per hour} = \frac{\text{gpm per sprinkler}}{\text{spacing product}} \times 96.3.$$

Example: 8 gpm sprinklers on 40 x 60

$$\text{in/hr} = \frac{8 \times 96.3}{40 \times 60} = \frac{770.4}{2,400} = 0.32 \text{ in./hr.}$$

Center-pivot system - maximum appropriate application rate to control runoff and/or redistribution:

Maximum application rate should not exceed infiltration capacity of the soil.

Symbols:

i - infiltration capacity of the soil in inches per hour

r - length of the moving lateral in feet

d - width of strip (feet) receiving water at any given moment

SR - maximum system capacity requirements to meet crop needs in inches per day

$$r_{max} = \frac{24 \times d \times i}{3.14 \times SR}$$

Example:

If: i = 0.50 in./hr.
SR = 0.45 in./day
d = 100 feet

then:
r_{max} = 850 feet.

APPENDIX B

Table B-1. Net Monthly Irrigation Requirement for Alfalfa Which Would Likely be Adequate for the Period Specified[a/]

Adequate (no. of years)	Hermiston 5/10 in/mo	7/10 in/mo	8/10 in/mo	9/10 in/mo	19/20 in/mo
May..................	4.47	4.87	5.13	5.49	5.80
June..................	6.39	6.84	7.03	7.28	7.54
July..................	8.54	8.87	9.04	9.37	9.46
August................	6.82	7.09	7.36	7.64	7.96
September.............	3.74	4.10	4.28	4.46	4.64
ANNUAL TOTAL..........	33.71	34.38	35.04	36.04	36.71

a/ Monthly values were computed independently, and did not all occur in the same year. Annual total does not equal the sum of the months, as it was calculated independently on an annual basis.

Table B-2. Average Peak Daily Consumptive Use of Alfalfa at Hermiston (Calculated by M. E. Jensen for Short Periods)

Length of period (days)	1955 in/da	1956 in/da	1957 in/da	1958 in/da	1959 in/da	1960 in/da	1961 in/da	Mean in/da
1	.420	.411	.400	.398	.423	.428	.426	.410
5	.364	.399	.348	.362	.366	.384	.381	.365
10	.338	.378	.327	.349	.338	.372	.364	.345
20	.319	.342	.311	.341	.314	.332	.350	.323

Table B-3. Peak Period Average Daily Consumptive Use Rates (U_p) as Related to Estimated Actual Monthly Use (U_m)

Net irrigation application (inches)	Computed peak monthly consumptive use rate (U_m) in inches[a/]								
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
	Peak period daily use rate (U_p) in inches per day								
1.0	.24	.26	.28	.31	.33	.35	.37	.40	.42
1.5	.23	.25	.27	.29	.32	.34	.36	.38	.41
2.0	.23	.25	.27	.29	.31	.33	.35	.37	.39
2.5	.22	.24	.26	.28	.30	.32	.34	.36	.39
3.0	.22	.24	.26	.28	.30	.32	.34	.36	.38
3.5	.21	.23	.25	.27	.29	.31	.33	.35	.37
4.0	.21	.23	.25	.27	.29	.31	.33	.35	.37
4.5	.21	.23	.25	.27	.29	.31	.33	.35	.37

a/ Based on the formula $U_p = 0.034\ U_m^{1.09}\ I^{-.09}$ where

U_p = Average daily peak period consumptive use, in inches,

U_m = Average consumptive use for the peak month, in inches,

I = Net irrigation application, in inches.

SOURCE: Technical Release 21, Soil Conservation Service, USDA, April 1967.

Table B-4. Example Irrigation Intervals for an Allowable Depletion of 2.5 Inches to Meet Irrigation Requirements 8 Years out of 10 in Case 2

Month	Interval (days)
April....................	24
May......................	14
June.....................	10
July.....................	8
August...................	10
September................	18
October..................	30