TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

TN - AGRONOMY-31

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Planning and Managing Irrigated Pasture

Irrigated pastureland as discussed in the information following is confined to lands suitable for use as pastureland that has adequate water available for full season irrigation. Pastureland without adequate full-season water is best planned as non-irrigated pasture having access to some supplemental water. Short-water pastures have limitations similar to dryland pastures with production varying annually according to availability of water for forage growth.

The purpose of this technical note is to provide basic guidelines for irrigated pasture planning and management in California. The information following, supplemented by local observations and technical data, should give SCS conservationists an organized approach for developing irrigated pasture management plans.

GENERAL INFORMATION

Irrigated pasture management consists of employing principles needed to attain maximum long term profits from the grazing unit. The correct intensity of management is attained by applying only those measures that will pay for themselves in increased production.

Large grazing units, good soils, and plentiful high quality water are primary elements assuring success of very intensive management systems. Smaller units and units with soil and/or water limitations are less responsive to intensive management in terms of return per unit of cost for intensification.

CRITERIA FOR ACHIEVING MAXIMUM PASTURE YIELDS:

1. Establish a dense weed-free stand of locally proven high producing grass and legume species.

2. Develop a system of rotation grazing that provides for:

   a. Optimum regrowth periods between grazing intervals.

   b. Applying plant nutrients as needed.

   c. Keeping livestock off wet fields.

d. Supplying efficient irrigations as needed for maximum growth.

e. Spreading droppings and clipping the pastures as needed for even distribution of grazing and weed control.

f. Beginning each grazing season on a different pasture.

g. Removing forage surpluses for hay or ensilage.

ACHIEVING EFFICIENT USE OF THE WATER SUPPLY

Pasture managers needing to make full use of irrigation systems of limited daily output will require pasture rotations that permit irrigation water to be applied on some part of the pasture area constantly during the season of peak use. For example, with the exception of the central coast and coastal valley, California pastures will use 0.25 inch of water or more per day during July and August (See Table 1). On such pasture, a 500 gpm well operated constantly would meet the water needs of only about 70 acres, assuming 70% efficiency. About ten acres of potential capacity would be lost for each day per week that water could not be applied.

TABLE 1

IRRIGATED PASTURE WATER USE IN NET INCHES PER DAY
(California Department of Water Resources Estimates)

CALIFORNIA AREA

MONTH	Central Coast	Central Coastal Valleys	Central Valley	Northeast Mountain Valleys
January	0.060	0.060	0.033	0.020
February	0.074	0.074	0.060	0.033
March	0.104	0.106	0.100	0.066
April	0.130	0.147	0.158	0.124
May	0.154	0.187	0.205	0.170
June	0.169*	0.208	0.260	0.220
July	0.167	0.236*	0.275*	0.290*
August	0.157	0.210	0.237	0.255
September	0.127	0.164	0.174	0.178
October	0.107	0.127	0.117	0.097
November	0.057	0.077	0.077	0.037
December	0.047	0.057	0.027	0.017
MEAN ANNUAL USE (feet)	3.4	4.1	4.3	3.8

Careful planning is required to organize rotation systems that permit daily irrigation without turning livestock into wet pastures. Figure 1 illustrates 5 systems that permit daily water application with 2 or 3 days drying time before grazing. Note that such systems require 7 pastures or more to attain regrowth periods needed for optimum performance of most forage species.

On units where water supplies or irrigation systems are not limiting, pasture rotations can be designed so that irrigation is not necessary every day. Figures 2 and 3 illustrate 7 such rotations designed to meet various conditions imposed by soil and forage species differences. In each case rotation shown in Figures 2 and 3 are systems where all odd numbered pastures would be irrigated on one day and all even numbered pastures on another with evenly spaced intervals between irrigations. These rotations are designed primarily for use with border or basin irrigation systems where the pasture manager can preschedule large quantities of water or have it on demand.

Figure 1 - Representative Rotation Systems Permiting Daily Use of Irrigation Systems

Day of Rotation	Systems 1-a, 1-b, 1-c Pasture No. 1	2	3	4	5	6	7	8	9	10	System 2 Pasture No. 1	2	3	4	5	6	7	System 3 Pasture No. 1	2	3	4	5	6	7	8	9	Day of Rotation
1	G	D			I					I	G						I	G								I	1
2	G	D	I					I			G	I						G	I								2
3	I	G	D			I					G	D		I				G	D		I						3
4		G	D	I					I		G	D				I		G	D				I				4
5		I	G	D			I				I	G						G	D						I		5
6			G	D	I					I		G	I					I	G								6
7			I	G	D			I				G	D		I				G	I							7
8	I			G	D	I						G	D				I		G	D		I					8
9				I	G	D			I			I	G						G	D				I			9
10		I			G	D	I						G	I					G	D						I	10
11				I	G	D				I			G	D		I			I	G							11
12			I			G	D	I			I		G	D						G	I						12
13	I					I	G	D					I	G						G	D		I				13
14				I			G	D	I					G	I					G	D				I		14
15		I					I	G	D					G	D		I	I		G	D						15
16					I			G	D	I		I		G	D					I	G						16
17			I					I	G	D				I	G						G	I					17
18	I								G	D					G	I					G	D		I			18
19	D								I	G	I				G	D					G	D				I	19
20	D									G			I		G	D			I		G	D					20
21															I	G					I	G					21
22	10 Day Rotation															G	I					G	I				22
23	with 5 pastures											I				G	D					G	D		I		23
24	irrigating 1													I		G	D		I			G	D				24
25	pasture per day															I	G			I		G	D				25
26	or										I						G				I	G					26
27	20 day rotation										D		I				G					G	I				27
28	with 10 pastures										D				I		G					G	D		I		28
29	irrigating 2																		I			G	D				29
30	pastures per day																			I		G	D				30
31	or																					I	G				31
32	30 day rotation																						G	I			32
33	with 15 pastures																	I					G	D			33
34	irrigating 3																		I				G	D			34
35	pastures per day																				I		G	D			35
36																							I	G			36
37																								G	I		37
38	G = Graze																	I						G			38
39	D = Dry																		I					G			39
40	I = Irrigate																				I			G			40
41																								I	G		41
42																		I							G		42
43																		D							G		43
44																		D							G		44
45																		D							G		45

Figure 2 - Representative 24 Day Rotation Systems

Day of Rotation	System 4 Pasture No. 1	2	3	4	5	6	7	8	System 5 Pasture No. 1	2	3	4	5	6	System 6 Pasture No. 1	2	3	4	Day of Rotation
1	G	I		I		I		I	G	I		I		I	G	I		I	1
2	G	D							G	D					G	D			2
3	G	D							G	D					G	D			3
4	I	G	I		I		I		G	D					G	D			4
5		G	D						I	G	I		I		G	D			5
6		G	D							G	D				G	D			6
7		I	G	I		I		I		G	D				I	G	I		7
8			G	D						G	D					G	D		8
9			G	D						I	G	I		I		G	D		9
10	I		I	G	I		I				G	D				G	D		10
11				G	D						G	D				G	D		11
12				G	D						G	D				G	D		12
13		I		I	G	I		I	I		I	G	I			I	G	I	13
14					G	D						G					G	D	14
15					G	D						G					G	D	15
16	I		I		I	G	I					G					G	D	16
17						G	D			I		I	G	I			G	D	17
18						G	D						G	D			G	D	18
19		I		I		I	G	I					G	D	I		I	G	19
20							G	D					G	D	D			G	20
21							G	D	I		I		I	G	D			G	21
22	I		I		I		I	G	D					G	D			G	22
23	D							G	D					G	D			G	23
24	D							G	D					G	D			G	24

G = Graze
D = Dry
I = Irrigate

Figure 3 - Representative 30 to 40 Day Rotation Systems

Day of Rotation	System 7 Pasture No. 1	2	3	4	5	6	7	8	System 8 Pasture No. 1	2	3	4	5	6	System 9 Pasture No. 1	2	3	4	5	6	7	8	System 10 Pasture No. 1	2	3	4	5	6	Day of Rotation
1	G	I		I		I		I	G	I		I		I	G	I		I		I		I	G	I		I			1
2	G	D							G	D					G	D							G	D					2
3	G	D							G	D					G	D							G	D					3
4	G	D							G	D					G	D							G	D					4
5	I	G	I		I		I		G	D					G	D							G	D					5
6		G	D						I	G	I		I		I	G	I		I		I		G	D					6
7		G	D							G	D					G	D						I	G	I		I		7
8		G	D							G	D					G	D							G	D				8
9		I	G	I		I		I		G	D					G	D							G	D				9
10			G	D						G	D					G	D							G	D				10
11			G	D						I	G	I		I		I	G	I		I		I		G	D				11
12			G	D							G	D					G							G	D				12
13	I		I	G	I		I				G	D					G						I	G	I		I		13
14				G	D						G	D					G							G	D				14
15				G	D						G	D					G							G	D				15
16				G	D				I		I	G	I		I		I	G	I		I				G	D				16
17		I		I	G	I		I				G	D					G	D						G	D				17
18					G	D						G	D					G	D						G	D				18
19					G	D						G	D					G	D				I		I	G	I			19
20					G	D						G	D					G	D							G				20
21	I		I		I	G	I			I		I	G	I		I		I	G	I		I				G				21
22						G	D						G	D					G	D							G				22
23						G	D						G	D					G	D							G				23
24						G	D						G	D					G	D							G				24
25		I		I		I	G	I					G	D					G	D				I		I	G	I			25
26							G	D	I		I		I	G	I		I			G	I						G	D			26
27							G	D	D					G	D					G	D						G	D			27
28							G	D	D					G	D					G	D						G	D			28
29	I		I		I		I	G	D					G	D					G	D						G	D			29
30	D							G	D					G	D					G	D						G	D			30
31	D							G								I		I		I	G	I	I		I		I	G			31
32	D							G													G	D	D				D	G			32
33																					G	D	D				D	G			33
34																					G	D	D				D	G			34
35																					G	D	D				D	G			35
36															I		I		I		I	G									36
37	G = Graze														D							G									37
38	D = Dry														D							G									38
39	I = Irrigate														D							G									39
40															D							G									40

Table 2 - Criteria From FIGURES 1, 2, & 3 Shown in Tabular Form

Irrigation System No.	Peak Use Requires Irrigation Every	Irrigation Plus Dry-Out Time (Days)	Grazing Period Available (Days)	Regrowth Period For System (Days)	Length of Rotation (Days)	Number of Pastures Required
(From Figure 1, providing for daily water application)						
1-a	5th Day	3	2	8	10	5
1-b	5th Day	3	2	16	20	10
1-c	5th Day	3	2	24	30	15
2	7th Day	3	4	24	28	7
3	9th Day	4	5	40	45	9
(From Figures 2 & 3, providing for evenly spaced periodic irrigations)						
4	6th Day	3	3	21	24	8
5	8th Day	4	4	19	24	6
6	12th Day	6	6	19	24	4
7	8th Day	4	4	28	32	8
8	10th Day	5	5	25	30	6
9	10th Day	5	5	35	40	8
10	12th Day	6	6	30	36	6

OPTIMUM FORAGE REGROWTH PERIODS

20 to 25 days - tall fescue, creeping meadow foxtail, Kentucky bluegrass, white dutch clover (ladino)

25 to 30 days - orchardgrass, bromegrass, reed canarygrass, birdsfoot trefoil, red clover, alsike clover, narrowleaf trefoil

30 to 35 days - intermediate wheatgrass, pubescent wheatgrass, tall wheatgrass, alfalfa, cicer milkvetch

PLANT NUTRIENT NEEDS

Optimum pasture yields are attained only by applying plant nutrients in sufficient amounts to overcome soil deficiencies and replenish nutrients removed by each year's growth. Grass pastures will invariably respond to nitrogen and may need phosphorus. Mixed grass and legume pastures will usually need phosphorus and often respond profitably to sulfur. Usually pastures including legumes will give some response to nitrogen, except nitrogen should not be used on legume seedings or those that are 75% or more legume by forage weight. Legumes in mixtures or pure seedings should be properly innoculated. Pasture legumes are responding to lime and molybdenum on a few California soils.

Soil testing is the most reliable method of determining pasture fertilizer needs. In absence of soil tests, local Soil Conservation service or Extension Service recommendations are the usual best source of information.

STOCKING RATE

FIX

Potential Stocking Rate (AUM) = Estimated annual forage yield (dry weight) in pounds per acre divided by 1000.

Thus, an acre capable of yielding 10,000 pounds hay should provide about 10 AUM's of grazing per season under intensive management.

SUGGESTED STEPS FOR PLANNING NEW PASTURE ROTATIONS

1. Obtain needed soils information for area being planned.

   a. Available water holding capacity.
   b. Any limitations to forage growth (salts, rooting depth, extremely light or heavy surface texture, fertility problems, acidity or alkalinity problems).
   c. Any soil or topographic limitations to type of irrigation system that can be used.

2. Determine existing forage species or select the grass and/or legume to be used.

3. Determine optimum regrowth interval for species to be used (A SITE-SPECIFIC GROWTH CURVE CAN HELP HERE)
4. Determine how often irrigation will be needed during peak-use months.

5. Select irrigation system to be used and confirm that sufficient water is available to service the acreage being considered. Determine if the water source will require daily use to keep up with the peak-use demand. If so, selection of systems from those illustrated in Figures 1, 2, or 3 would be limited to systems 1, 2, or 3 of Figure 1.

6. Using the information from steps 1 through 5, select the rotation system from Figures 1, 2, or 3 that appears to be the best fit or devise a separate system from alternatives available.

When the rotation system is selected from Figures 1, 2, or 3, information provided in Table 2 can be used to complete the "Schedule For One ____ Day Rotation Cycle" illustrated on the trial planning form (example attached). The pasture management plan is completed by preparing the pasture arrangement sketch and filling in other applicable information on the planning form.

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State Conservation Agronomist

Attachment

Trial

IRRIGATED PASTURE PLAN AND MANAGEMENT SYSTEM

(Reference: California Agronomy Technical Note No. 31)

Resource Conservation District _____ Field Office _____

Cooperator _____ Location _____

Community No. _____ Referral No. _____ Field No. _____

SCHEDULE FOR ONE ____ DAY ROTATION CYCLE

Pasture Number	Grazing Interval	Irrigate on Days Number	Regrowth Period
1	day 1 to ____	____, ____, ____, ____, ____	day ____ to ____
2	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
3	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
4	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
5	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
6	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
7	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
8	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
9	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____
10	day ____ to ____	____, ____, ____, ____, ____	day ____ to ____

Pasture species _____

_____

Approximate grazing season

_____

Estimated stocking rate
AUM per acre per year _____

Planned annual fertilizer program

Month	Nitrogen	P_2O_5	Other

Type irrigation system _____

_____

_____

_____

PASTURE ARRANGEMENT SKETCH

Estimated Pasture Gross Water Requirement per Irrigation

Month	Days Between Irrigations	x Net Daily Requirement (inches)	x $\frac{100}{\%\ \text{Efficiency}}$	+ Leaching Requirement (inches)	= Gross Water per Irrigation (inches)
January					
February					
March					
April					
May					
June					
July					
August					
September					
October					
November					
December					

Additional Remarks:

SCS Technician's Signature

Date