Importance of Irrigated Grasslands in Animal Production[1]

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Irrigation is tremendously important to the agriculture of the western United States; and water, on which it is based, is a primary requirement for the industrial and economic development of the region. Anyone at all familiar with the difficulties encountered in partitioning the waters of the Colorado River realizes this must be so. Garnsey (1950) wrote a book in support of the hypothesis that the Upper Basin States would forever remain a hinterland if they failed to hold fast to their share of the waters of the Colorado River.

According to Clyde (1958) irrigation in the 17 western states (96 percent of the national total) uses just over 80 billion gallons of water daily. The nation's industrial use of water is about the same. The human requirement is 17 billions daily. Industrial use is increasing so rapidly that it is estimated at 215 billion gallons daily by 1975, with irrigation at 110. The nation receives about 4.3 trillion gallons daily as snow and rain. The problem is thus less one of total supply than of distribution. Industry is expanding most rapidly in the West, where it competes for water directly with irrigation, although many industrial processes do not consume the water, but require only its temporary use. Multiple use of water is of great importance in the arid West.

In round numbers there are 30 million acres of irrigated land in the 17 western states, of which nearly half, 14 million acres, produce forage. In addition, 18 million acres of non-irrigated land produce forage (figure 1). Most of the irrigated alfalfa and nearly all the irrigated pastures are in the 11 western states. Haylands in the 11 western and 6 plains states are presented in figure 2. Note the large acreage of wild hay in the plains states. For numbers of cattle and sheep in the 11 western and 6 plains states see figure 3. Note that in terms of animal units (5 sheep = 1 cow) cattle are 10 times as important as sheep.

The extent to which western livestock graze on National Forest lands is presented in figure 4. Note that 1 of every 9 cows and 2 of every 9 sheep obtain summer feed on the National Forests, the total grazing obtained being about 7 percent of the total need. Approximately 61 million acres of National Forest lands are grazed. The Bureau of Land Management, with 187 million acres under grazing in the western United States, contributes a little more than the Forest Service to cattle grazing

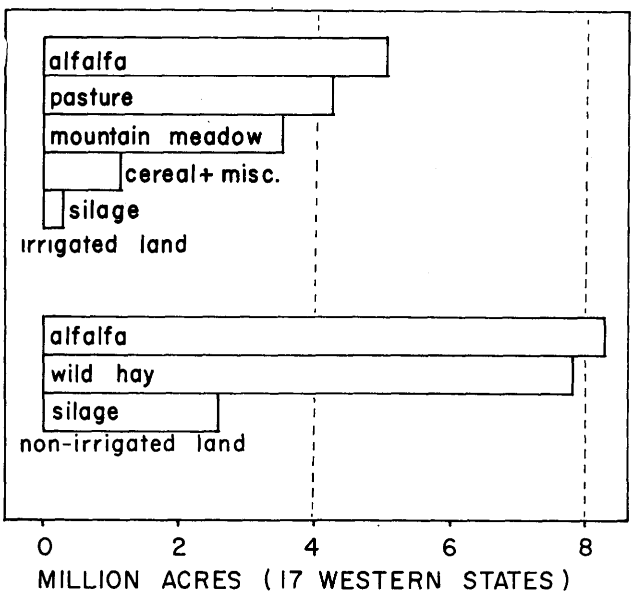

FIGURE 1. Hay and silage acreage in the 17 western states. About half the total irrigated acreage produces forage. From 1954 census of Agriculture.

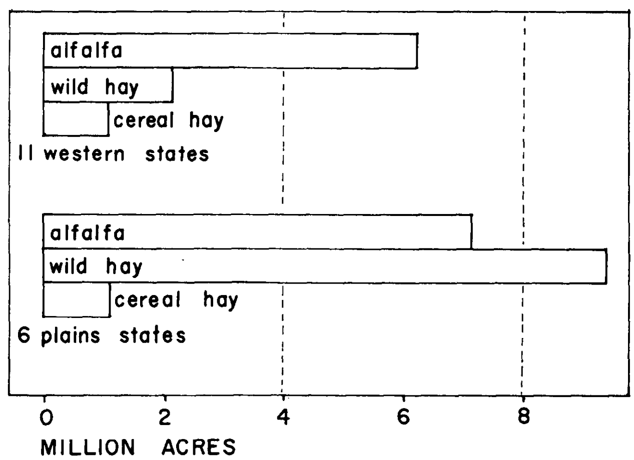

FIGURE 2. Hay crops in the 11 western and 6 plains states. Note the importance of alfalfa in both areas and the large acreage of wild hay in the plains states. From 1954 census of Agriculture.

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and about twice as much to sheep. The relationship between domestic livestock and big game (chiefly deer) on National Forest lands is illustrated in figure 5.

Alfalfa is clearly the most important harvested forage crop in the 17 western states. There are 13.3 million acres of alfalfa of which ⅖ are irrigated. With irrigated acreages of 5 million for alfalfa, 4.5 million for pastures, 3.5 million for mountain meadows and approximately a million each for silage and grains cut for hay there can be little doubt about the importance of irrigation to animal production in the western United States.

Alfalfa is particularly adapted to the basic soils of the West. It is a high producer of nutritious forage comparatively high in nitrogen. It responds to water in almost any amount and is easily made into hay. Although it has been subjected to some serious diseases and pests, resistant varieties or effective management practices have been developed as each need arose. Within a given area, methods of establishing, producing and harvesting the crop have become fairly well standardized. It is likely that alfalfa will become increasingly important in the western states. The degree to which alfalfa can be depended upon to produce a crop every year, in the West, is something that ranchers, dealing with generally overstocked ranges with a high dependence on the vicissitudes of nature, can appreciate to the fullest.

In contrast to alfalfa, irrigated pastures have presented an entirely different set of problems. When the West was settled pastures were either available on wet valley-bottom lands or were established on areas not suitable for intensive cultivation. The prevailing system of management was continuous close grazing and flood irrigation, without application of fertilizer. Under this management these pastures, no matter what they contained to begin with, soon reverted to Kentucky bluegrass and white clover, the clover disappearing if irrigation was neglected.

Before improved methods of pasture management could be developed, or much interest shown in them, pressure for pasture products had to be sufficient for pastures to expand onto arable land. Dairy products generated this pressure and along with rotation grazing set the stage for the direct comparison of pastures with other crops. This led to research. The high productive potential of irrigated pastures, which this research brought to light, has yet to make its impact on the agriculture of the West. Facts now available, however, assure that irrigated pastures will become of much greater importance in the future in animal production in the western states.

Although a few early researchers made notable progress, as have others currently active, it is to the comprehensive and fruitful investigations under the leadership of Bateman at the Utah Station that we are largely indebted for the present promise of irrigated pastures. Carried out over a quarter of a century, these studies were always incorporated into the management of the dairy herd (Bateman et al., 1949) which increased from about 35 milking cows and their young stock to double that number and never lacked for the acid test of practical application on a field scale. Some of these investigations are as follows:

(1) Bateman (1940) reported a study conducted with D. W. Pittman. One application of 600 pounds treble superphosphate

FIGURE 3. Cattle and sheep in the 11 western and 6 plains states. In terms of animal units cattle are 10 times as important as sheep. From 1954 census of Agriculture.

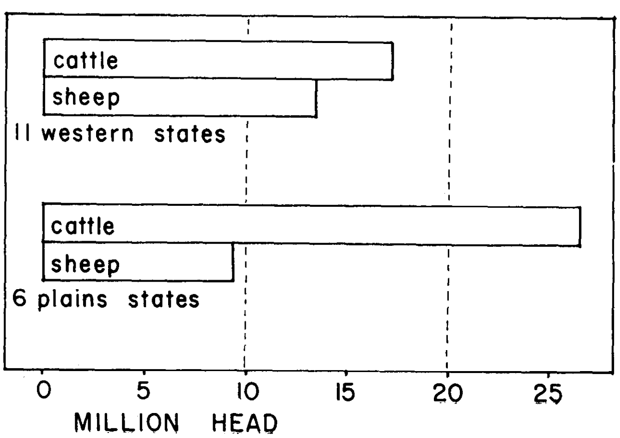

FIGURE 4. Cattle and sheep grazing on National Forest ranges, the percent of all beef cattle and stock sheep in the western states, and the percent of total grazing requirements of western livestock furnished by National Forest ranges. From 1953 report, Chief of Forest Service.

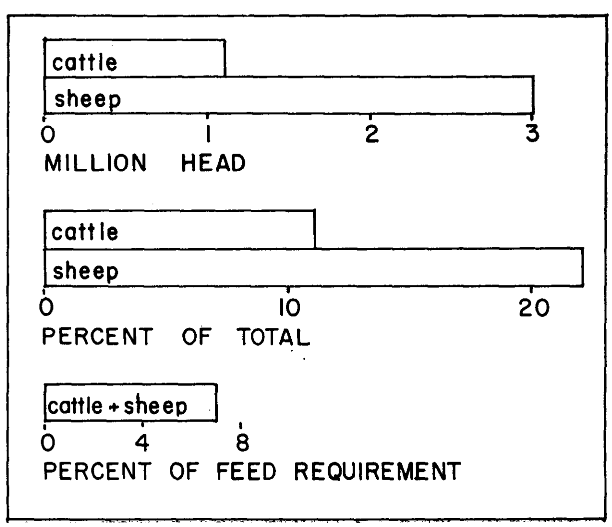

Table 1. Suggested pasture mixtures and rates of seeding on a good seedbed for 9 conditions common in the Intermountain Region. From the Utah Agr. Exp. Sta., with some modifications.

LEGEND

$\boxed{5}$ Best use.

$\boxed{/////}$ Range of adaptation.[1]

	Well-drained dryland: Poor to ave.	Well-drained dryland: Very good	Salty soil. Part-season drought	Irrigation water for early summer only	Irrigation water except for late summer	Irrigation water all season (Best crop land)	Cultivated land too wet for alfalfa	Land too wet for cultivation	Salty soil too wet for cultivation
Crested wheatgrass	5	/////							
Intermediate wheatgrass		5		/////					
Tall wheatgrass		/////	5	/////					
Smooth bromegrass				8	4	4	/////		
Tall oatgrass				/////	4	4			
Orchardgrass					3	3			
Reed canarygrass				/////	/////	3	5	5	5
Alfalfa (wilt-resistant)	3	3	/////	5	5	3			
Sweet clover	/////	/////	5	/////	/////	/////	/////	/////	/////
Red clover					/////	3	2	/////	
Ladino clover						1	1	/////	
Alsike clover						/////	1	2	
Strawberry clover						/////	1	1	1
Tall fescue [2]				/////	/////	/////	/////	/////	/////

[1] The slant-marked blocks extend the range of adaptation of each species to areas where they may be valuable under some conditions. For example, Reed canarygrass once established is highly productive throughout the slant-marked zones, but good stands of it are difficult to obtain without abundant water. Likewise, widely adapted sweet clover is not so desirable a pasture plant as alfalfa, but might be used on dryland to safely extend the grazing period without danger of bloat.

[2] Tall fescue and all varieties of it (Alta fescue, Kentucky 31 fescue, etc.) though widely adapted, are not recommended because of low palatability.

(43 percent P_2O_5) resulted in an average increase of 63.8 percent over a 5-year period. Another treatment of 200 pounds treble superphosphate and 10 tons manure gave a 3-year average increase of 34.4 percent. On the basis of these studies the dairy farm pastures were placed under a fertilization program of 10 to 15 tons manure directly from the barn plus 200 pounds treble superphosphate every 3 years. This was later changed to every 2 years (Bateman, 1943) following a response of 95.7 percent the same season from an application in the spring of 6.8 tons manure and 200 pounds treble superphosphate.

(2) During 1942-44 the rate of spring and early-summer growth of pasture was determined by Bateman (1952) for 4 fields grazed in rotation. The results of this study are presented in figure 6. Note the tremendous vigor of pastures early in the season. Grazing must also begin early and be carefully controlled. Otherwise, extra acres must be harvested as hay.

(3) Bateman has rather consistently obtained yields of 60-80 bushels of barley per acre seeded as a companion crop to alfalfa or pasture. His philosophy is that if a companion crop is not sown there will be one of weeds. (Stapledon (1949) has shown that the ryegrasses are much more competitive against other grasses than is a cereal cover crop.) Success with a companion crop, on irrigated land, requires fertile soil, a firm, clean seedbed, early-spring seeding, and meeting the moisture needs of the small-seeded crop. Barley is recommended at 50 pounds per acre (Bateman, 1956, 1958).

(4) Production per acre from pasture has been reported as pounds of total digestible nutrients, pounds of milk (4 percent fat-corrected), pounds of butterfat, or combinations of these with gain or loss in body weight of the grazing animals. Such production records led to a search for more productive mixtures (Bateman and Keller, 1956). Some relationships are presented in figures 7 and 8.

The recommended mixture has consistently yielded 5000 pounds

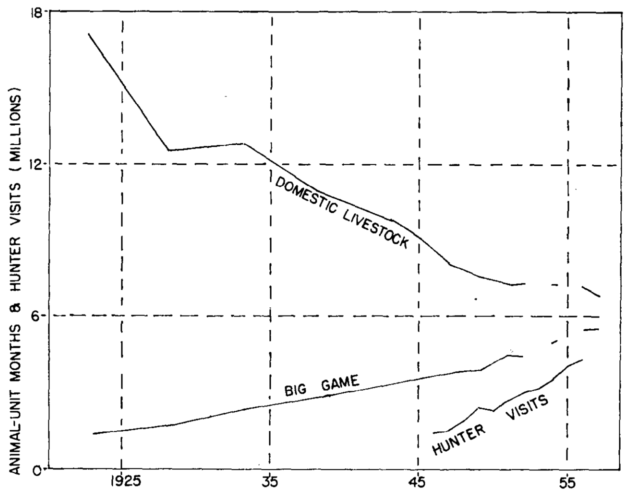

FIGURE 5. Animal-unit months of grazing provided domestic livestock and big game animals on National Forest ranges 1923-1957. From 1953 report, Chief of Forest Service, with additions from Division of Range Management. Hunter visits from 1957 Agricultural statistics.

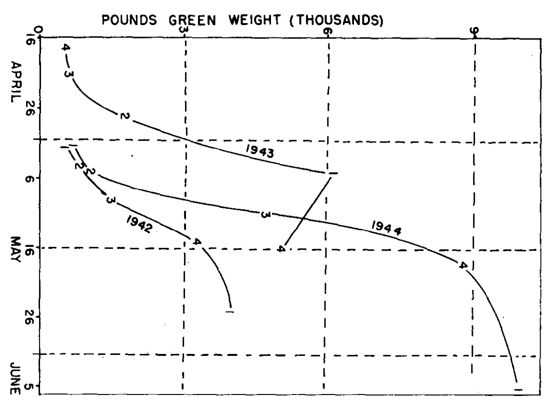

FIGURE 6. Early-season growth of pasture forage during 1942-44 on 4 pastures grazed in rotation (pastures numbered 1 to 4). Dairy Experimental Farm, Utah Agricultural Experiment Station.

or more of total digestible nutrients per acre, and when grazed by dairy cows with a 400-pound butterfat average has consistently yielded above 8000 pounds of 4 percent fat-corrected milk, or 320 pounds of butterfat. In 1953 20 acres averaged 9007 pounds and 332 pounds of butterfat from pasture alone (Bateman, 1956).

Table 1 presents the recommended mix, arrived at by rather extensive experimentation, and suggested mixtures for different conditions prevalent in the western states (taken with some modification from Utah Extension Bulletin 173, Department of Agronomy, 1949).

In a recent study (Bateman, 1958; Bateman, et al., 1958) Bateman and associates compared grazing with green chop fed in dry lot. Milk production per acre was identical, but labor and machinery requirements of green chop made it the more costly practice. Current literature contains reports that under grazing as much as 30 percent of the feed is wasted. In this connection it is interesting that the Utah study reports 46 pounds dry-weight forage per acre refused under grazing and 114 pounds when fed in dry lot. This is an illustration of the efficiency of utilization possible when irrigated pastures are properly managed.

In 1948 LeRoy Bunnell and a former high school student, Mack Hansen, produced 952 pounds of beef per acre on an 8-acre pasture seeded to the new Utah mixture. After accounting for 2.3 tons of barley and 3.2 tons of alfalfa hay fed, they obtained a return of $213 per acre from the pasture (McVickar, 1951).

Heinemann and Van Keuren (1955, 1958a, 1958b) and Van Keuren and Heinemann (1956, 1958) have consistently approached and sometimes exceeded 1,000 pounds of beef or mutton per acre, from irrigated pastures seeded to simple mixtures.

True and Hoveland (1955) have written: "It is possible to produce 1,000 pounds beef gain or milk equivalent per acre on well-managed irrigated pastures in south Texas. Irrigated pastures offer good profits in milk or beef production and the best known method of soil improvement."

According to Staten et al. (1951) well-managed irrigated pastures should carry 3 cows and their calves from April 1 to November 15. They report the experience of farmers that a well-grown and well-managed pasture can be expected to produce 1,000 to 1,500 pounds or even more of beef per acre. They estimate that it costs $42 to establish an acre of pasture and $72 a year to maintain it.

In a preliminary report Jensen and Madsen (1957) give production of beef from Kentucky bluegrass pastures in Nevada for 1957. Pastures given 50 pounds N per acre in March and 55 pounds in July yielded 693 pounds of beef per acre as compared with 498 pounds when no fertilizer was applied. Under each treatment grazing was rotated at 2-week intervals between 2 pastures. In 1958 the fertilized pastures received 36 pounds of N in March, June, and

August (Jensen and Madsen, 1958). Two years of nitrogen fertilization reduced the clover content of the pasture to 5 percent. The unfertilized pastures which contained 41 percent clover actually out yielded those receiving 108 pounds N by 10 percent. Considering the extent of old bluegrass pastures in the western United States, these data are of considerable significance.

During the past season Animal Husbandry and Dairy at Utah State cooperated in grazing yearling Hereford steers on a new 22-acre pasture seeded after leveling and draining the land. The pasture produced 1,078 pounds of beef per acre. No supplements were fed (Dew, 1958).

Research on the improvement of mountain meadows in the West probably began with the studies of Stewart and Clark (1944) in Wyoming and Pittman in Utah (Pittman and Nielsen, 1950) and is now in progress particularly in Oregon, Colorado, and Wyoming. In these studies the effects of high levels of nitrogen (Willhite and Rouse, 1956), new species combinations (Lewis, 1955), and management practices (Cooper, 1957) to improve the quality of forage as well as the yield are making significant progress. Mountain meadows offer great potential for increased productivity, particularly where some degree of water control can be obtained.

Water is so important to the western United States that it is a paradox almost beyond belief that it is so extravagantly and inefficiently used. Lauritzen (1955) estimates that "about ⅓ of all water diverted for irrigation is lost in conveying it to the land . . . another ⅓ percolates too deeply or runs off during the process of application to the land." Stansberry (1955), discussing irrigation of alfalfa, states that if 70 percent of the water is used by the plant, efficiency is good, but "in many places not more than half the water delivered to the farm is utilized by the alfalfa plant."

According to Dominy (1958) the U. S. Geological Survey estimated that 21 million acre-feet of water are lost each year by evaporation from fresh water lakes, reservoirs and streams in the 17 western states and that a much greater annual loss is in water consumed by undesirable vegetation around reservoirs, along natural water channels, canals and ditches. Among the plants involved are phreatophytes, which Dominy reports have encroached on 17 million acres of land and use an estimated 25 million acre-feet of water per year. Experiments now in progress indicate that on water bodies with low surface movement evaporation can be greatly reduced by applying a film of Hexadecanol.

Much progress is being made through canal and ditch lining in reducing losses by percolation (Lauritzen et al., 1952; Lauritzen and Peterson, 1953; and Lauritzen, 1955). Great strides have been made in determining how to control undesirable vegetation economically (Timmons

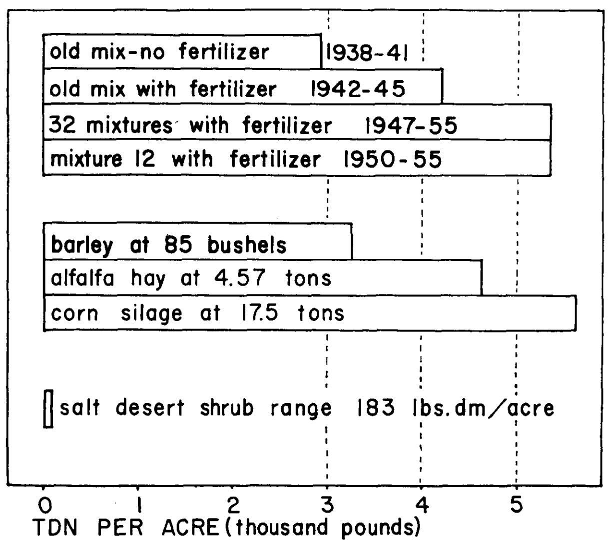

FIGURE 7. Production of pounds TDN from pasture and other feed crops at the Dairy Experimental Farm, Utah Agricultural Experiment Station.

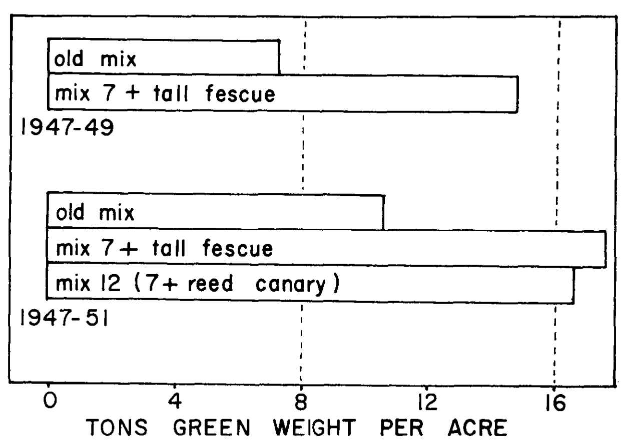

FIGURE 8. Tons green herbage per acre from the Huntley mix and new mixtures under rotation or strip grazing at the Dairy Experimental Farm, Utah Agricultural Experiment Station.

and Klingman, 1958) and we have for some time had the knowledge necessary to irrigate properly, so as to avoid excessive run-off or percolation beyond the roots of crop plants, if we but apply it.

Inefficiently as irrigation water appears to be used by farmers whose entire enterprise depends on it, the use of water by ranchers is apparently even less efficient. Saunderson (1950) wrote this: "Generally the tendency has been for the stock ranch to economize on labor rather than water, with the result that the water is not used efficiently by the standards of intensive crop agriculture." He then pointed out that the labor requirement to produce a ton of harvested hay is lower for irrigated than for non-irrigated land, largely because of the low yields of the latter.

Even though it may appear that all available water resources of the West are being used, by the prevention of waste alone irrigation could be greatly extended.

Ranchers seeking a better balance in their feed supply, or greater stability for the future, should thoroughly investigate the possibility of developing irrigated alfalfa or improved irrigated pasture on their private lands. It is a reasonable estimate that ranchers not able to do this may strengthen their position by acquiring lands suitable for this purpose.

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