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# **Irrigation in Montana**

**Fortier Samuel**

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**Author: Fortier Samuel**

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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 172 (Revised).

A. C. TRUE, Director.

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# IRRIGATION IN MONTANA.

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BY

SAMUEL FORTIER,

ASSISTED BY

A. P. STOVER AND J. S. BAKER.



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**LETTER OF TRANSMITTAL.**

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**U. S. DEPARTMENT OF AGRICULTURE,**  
**OFFICE OF EXPERIMENT STATIONS,**  
*Washington, D. C., October 20, 1906.*

SIR: I have the honor to transmit herewith a revised report on Irrigation in Montana, prepared by Samuel Fortier, assisted by A. P. Stover and J. S. Baker, under the direction of Elwood Mead, Chief of Irrigation and Drainage Investigations, and to recommend that it be published as a bulletin of this Office for circulation primarily in Montana, although its suggestions should be of value to the arid region generally.

Respectfully,

A. C. TRUE,  
*Director.*

Hon. JAMES WILSON,  
*Secretary of Agriculture.*

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# IRRIGATION IN MONTANA.

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In the early stages of agricultural development in Montana, as in the other arid States, the economical use of water was not important. The supply was large in proportion to the demand, and securing capital to build irrigation works, and methods of building ditches, preparing land, and applying water were the important matters. But those conditions are passing, and the State is entering upon the stage in which continued agricultural development will depend upon the economical use of its water supplies. This report is based upon a study, made for the purpose of determining whether the existing methods and institutions will lead to the best use of water. The work included the study of irrigation practice in Gallatin and the Yellowstone valleys; seepage losses from ditches and methods of prevention throughout the State; volume of return seepage to streams in the Bitter Root Valley; and water-right records in the Gallatin Valley. It is believed that this study of typical localities gives a fair understanding of conditions throughout the State.

## LAND AREAS.

On June 30, 1903, there were over 18,000,000 acres of Government land in the State open for settlement under the various laws. On the same date there was nearly 40,000,000 acres unsurveyed. These two items comprise nearly 65 per cent of the total land area. The area included in the forest reserves is about 7,500,000 acres, and the six Indian reservations prior to the opening of a part of the Crow Reservation aggregated about 9,500,000 acres. In addition, there is the area appropriated, which has increased of late years by more than a million acres a year. In 1899 it was 13,000,000 and in 1905 it was 19,279,000 acres. A more exact statement, taken from the Report of the Commissioner of the General Land Office regarding the status of land in Montana on July 1, 1905, is herewith given:

	Acres.
Area surveyed and open for settlement.....	19,241,264
Area unsurveyed.....	36,507,106
Area reserved.....	18,566,188
Area appropriated.....	19,279,012

A considerable portion of the area appropriated has been purchased from the Northern Pacific Railroad Company. The grant to this company comprised about 15,000,000 acres, of which nearly one-half has been patented and sold to private parties. According to the Congressional Record of March 25, 1904, the public lands of Montana disposed of from July 1, 1881, to June 30, 1902, are as follows:

	Acres.
Timber and stone lands.....	171,977
Final desert entries.....	1,284,431
Commuted homesteads.....	383,121
Final homesteads.....	1,573,777
State lands selected.....	961,621
Railroad grants patented.....	6,611,083
Total in twenty-one years.....	10,986,010

Only about 10 per cent of the land that has been appropriated is farmed, and of this portion about two-thirds is irrigated. The total area irrigated in 1904 was probably 1,250,000 to 1,500,000 acres. It is from this comparatively small area that the greater part of the agricultural wealth, exclusive of stock interests, is derived, and from which a large part of the total revenues are raised. In 1902 the State board of equalization assessed 10,542,536 acres at \$25,300,972, or \$2.40 per acre. This average rate is low for the reason that unfenced grazing lands were assessed at only 75 cents and railroad lands at 85 cents per acre. On the other hand, first-class grain lands under irrigation were occasionally assessed as high as \$30 per acre. On an average, 1 acre of grain land is assessed as high as 10 acres of grazing land.

According to the census of 1902, 1,140,694 acres were irrigated in Montana. This was an increase of 18.1 per cent over the area irrigated in 1899. More land has been reclaimed during the two years that have followed than in the two that preceded that date, so that it is safe to assert that there are over 1,500,000 acres under irrigation.

#### THE WATER SUPPLY.

For an arid State, Montana is well watered. Occupying the crest of the continent, many rivers have their sources in its elevated ranges and mesas. Some of these streams have not as yet been utilized to any great extent for irrigation, and in consequence their water has little present value. Others are partially utilized, while still others have been wholly appropriated. However, only a few of the larger streams have ever been measured and little is known of the discharge of scores of the smaller rivers and creeks. The following summary of the annual discharge of some of the principal rivers in 1903, as determined by the engineers of the United States Geological Survey, may convey some idea of the extent of the water supply.



*Discharge of Montana rivers, 1903.*

	Acre-feet.
Yellowstone River at Livingston .....	2, 654, 000
Gallatin River at Logan .....	841, 000
Madison River at Morris .....	1, 285, 000
Jefferson River at Sappington .....	1, 872, 000
Bitter Root River at Grantsdale .....	1, 128, 000
Missoula River at Missoula .....	2, 459, 000
Big Blackfoot River at Bonner .....	1, 026, 000
Marias River at Shelby .....	1, 183, 000
St. Mary River at International Line .....	1, 213, 000
Total <sup>a</sup> .....	13, 641, 000

The water supply for 1903 was about normal. On account, however, of the short irrigation season the full flow of streams can not be utilized without storage for more than a third of the year. It is true this growing period occurs at a time when the rivers are high, but even with this favorable condition it is not possible to utilize for irrigation purposes more than one-half of the total yearly flow. The data regarding the quantities of water which can be retained in the smaller streams are too limited and uncertain to enable one to estimate with any degree of accuracy the number of acres which can be irrigated from these sources. From a more or less intimate knowledge of the water resources of the State, the writer would place the limit at 6,000,000 acres as being the largest amount of land which can be irrigated in Montana from all sources, including stream flow, storage reservoirs, and wells.

It may be stated in a general way that for every acre that can be irrigated there will be nearly 2 acres that may be cultivated dry and 10 acres that will afford pasture for stock. How to make the best possible use of 6,000,000 acres of irrigable lands, of 10,000,000 acres of arable bench lands, and of 50,000,000 acres of grazing lands is the most vital and far-reaching question that is likely to arise in Montana for the next quarter of a century. It has always seemed to the writer that the ideal farm in this mountain State would consist of 40 acres of irrigated land with a good water right, about 40 to 80 acres of arable bench land, and about 640 acres of fenced grazing land on a near-by mountain slope.

**CLIMATE.**

The climate of Montana is arid and is typical of much of the Rocky Mountain region, but nearly 70 per cent of the average precipitation of 14.5 inches occurs during the crop-growing season. Few records have been taken to show the heavy precipitation on the mountain slopes. The officers of Fort Yellowstone, in the Yellowstone National Park, claim that the depth of snow varies from 10 feet in the neigh-

<sup>a</sup>The Missouri River is not included for the reason that the greater part of its discharge is derived from the Gallatin, Madison, and Jefferson rivers.

borhood of Mammoth Hot Springs to 20 feet at the higher elevations within and adjacent to the park. The light snowfall in the valleys during the winter months is usually speedily evaporated by the chinook winds, which are met with from Oregon to Nebraska and from the Peace River to Arizona, and are particularly common in Montana, doing much to modify the climate.

While the temperature often reaches  $-40^{\circ}$  F. at Havre, which lies in the direct path of the winter storms from the north and northwest, the lowest record at Missoula for twenty-three years is  $-22^{\circ}$  F., and in some winters the mercury does not go below the zero point. In many parts of the State the spring months are the most disagreeable. March, April, and May are the worst, and the sunshine of June is often obscured by showers of soft snow. But with two hundred and seventy-three sunshiny days and only ninety-two rainy days in the year, the Montana farmer receives with gratitude his allotment of June snow, because it benefits his crops and may save him the work of a second irrigation.

#### CROPS.

In response to a large number of circular letters which were sent out in the summer of 1904 from the Montana Experiment Station, the yields and value of the ordinary crops grown in the principal irrigated valleys of the State were obtained. The accompanying statement represents the averages of all the complete replies received to an inquiry sent to representative farmers regarding the principal crops in their neighborhood, the average yields per acre, and the prevailing prices for the past few years:

*Crop returns in Montana.*

Kind of crop.	Yield per acre.	Price.	Value.
Wheat.....	33 bushels.....	\$1 per cwt.....	\$20.16
Oats.....	57.90 bushels.....	\$1.04 per cwt.....	19.27
Barley.....	56.50 bushels.....	\$1.03 per cwt.....	25.24
Alfalfa.....	4.18 tons.....	\$5.19 per ton.....	21.69
Timothy.....	1.46 tons.....	\$9.43 per ton.....	13.77
Clover.....	3.67 tons.....	\$5 per ton.....	18.35
Potatoes.....	200 bushels.....	50 cents per cwt.....	60.00
Deciduous fruits and berries.....			100.00

The yields with their corresponding values given in the table are considerably above the average of the irrigated portion of the State. In many parts both water and land are cheap, and careless methods of farming are practiced. The land is not properly cultivated and much of the water applied does more harm than good. Farmers seem to prefer to go to the expense and trouble of cultivating 100 acres in a slipshod manner for half a crop rather than to farm 50 acres in a skillful way for a full crop. The figures of crop yields, however, represent with a fair degree of accuracy what can be accomplished when care and skill are exercised in cultivating the soil and applying the water.

Nearly three-fourths of all the wheat and rye grown in the State are produced on dry farms. A large part of the oats and barley is also raised on dry farms, so that more than one-half of the entire cereal crop comes from the unirrigated farms. This branch of farming is increasing at a rapid rate. Plowed fields, which at one time were confined to the lowlands, are now found far up the mountain side, and it is safe to assert that in a very few years several million acres will be cultivated in this manner.

In developing this feature of its agricultural wealth Montana is imitating the course pursued by California. The valley lands of the San Joaquin and Sacramento valleys have been producing grain for forty years without being irrigated. The soil in these valleys is of great depth and at one time gave heavy yields, but the continuous cropping of grain without rotation has reduced the yield until now many farmers consider themselves fortunate when the returns at the close of the season's operations show no loss. The bench lands of Montana are likely to fail to produce profitable yields at an earlier period, for the reason that the soil is less deep. Some kind of a simple rotation with a leguminous crop should be introduced, if possible. The rains in the spring are quite abundant as a rule, and if these should fail or prove inadequate, sufficient water can usually be had from the neighboring creeks to thoroughly wet the soil during the early spring or late autumn months.

With sufficient moisture and a thoroughly prepared seed bed, it is believed that alfalfa can be successfully raised over much of the arable but nonirrigable lands. The yield would be, as a matter of course, much less than on properly irrigated land; one medium crop, and under favorable conditions two, would be the average yield; but the yield is of secondary importance. By a simple rotation of this kind the productive power of the soil could be maintained and the dry farms made to yield for an indefinite period.

#### **THE GALLATIN VALLEY.**

Gallatin County, comprising a total area of 1,663,000 acres, is an irregularly shaped tract of land occupying the south-central part of the State of Montana. The southern portion of the county is mountainous and extends to the boundary of Idaho and the Yellowstone National Park; the land to the north is less elevated and affords fairly good range, while the middle portion of the county contains the rich alluvial plain known as Gallatin Valley. This valley is 28 miles long and about 14 miles wide. Around the upper rim the fall varies from 50 to 80 feet per mile, while from the Missouri River to Bozeman the average grade on the Northern Pacific Railroad is somewhat more than 30 feet per mile. The elevation of the railroad track at Boze-

man, near the upper end of the valley, is 4,754 feet and at Logan, a small town located near the lower end of the valley and distant 24 miles, it is 4,032 feet. There is consequently a difference of 722 feet in elevation in 24 miles.

Gallatin Valley is for the most part surrounded by mountain ranges. To the south are to be found the sharp-pointed, snow-covered peaks of the Gallatin Mountains; on the east the steep incline from the East Gallatin River terminates in the Bridger Range, while a low range separates it from the valley of the upper Missouri River on the northwest and a plateau forms the divide between it and the Madison Valley on the west.

The people of Gallatin County paid taxes in 1902 on over half a million acres. This area was divided as follows:

*Private land in Gallatin County, 1902.*

	Acres.
First-class grain and hay land, most of which was irrigated . . .	98, 115
Second-class grain and hay land . . . . .	112, 910
Fenced grazing lands . . . . .	205, 130
Unfenced grazing lands . . . . .	73, 160
Railroad lands . . . . .	58, 831
Total . . . . .	548, 146

There were about 100,000 acres irrigated and about 110,000 acres cultivated dry in 1903. On an average 1 acre of irrigated land is as profitable as 3 or 4 acres of the same quality of nonirrigated land, for the reason that the former, under a proper rotation, will produce a crop every year while the latter has to be rested alternate years, the irrigated land producing also a greater diversity of crops.

In a general way the soils of the Gallatin Valley may be classed under two heads, viz, those derived directly from the disintegration of the materials of the Bozeman Lake beds and remaining in place and those formed by the sorting over of the above materials by the various streams of the valley. The first of these two classes constitutes the higher "bench" lands, while the other comprises the bottom lands bordering the streams or occupying the lower levels of the valley. These have much in common, yet there are also marked differences. Gravel is rarely found in the bench-land soil, while it is common in the bottom lands.

The thickness of the soil varies very greatly, averaging perhaps 12 inches, the subsoil averaging 2 feet, with usually gravel below. This is more particularly true of the bottom-land class. The soils are deeper and richer in humus in the upper end of the valley, whereas about the middle of the valley the gravel forms an extensive bar, reaching practically to the surface.