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**SAMUEL FORTIER & A. P. STOVER & J. S. BAKER**

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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.**

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.

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, 988, 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.....	1,265,000
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.