CONSERVATION ACTIVITIES IN WESTERN CANADA

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The paper reviews conservation activities in the three Prairie Provinces of Canada by Provincial Governments and the Prairie Farm Rehabilitation Administration of the Canada Department of Agriculture.

Progress in community pasture development as a measure towards better land use is shown by 532,000 acres under community pasture use in Alberta, 2,450,000 in Saskatchewan and 210,000 in Manitoba, with P.F. R. A. pastures constituting about two-thirds of the total in each province. About fifteen per cent of the occupied lands of the three provinces are administered by the Crown, of which two-thirds are grazing lands. Each province developed significant land use control programs to overcome problems in misuse that became evident during the nineteen thirties but these have slowed down materially since the war.

The administration of water laws has been transferred to the agricultural departments in each province. Irrigation has been the major water development program in Alberta and flood control in Manitoba, with Saskatchewan having lesser problems or opportunities in these fields. Both Alberta and Saskatchewan construct irrigation distribution systems at only nominal cost to the land owner. P.F. R.A. has accomplished a major program of water storage, having developed or assisted in a total of 60,316 projects with a capacity of 1,551,000 acre feet.

Conservation and land use receive major emphasis in the extension program in the three provinces. With the major conservation and land use problems developing on cultivated land, it is considered that programs helping to develop stable, well-operated farm businesses are an integral part of an overall conservation program. The provinces use special assistance programs, directed towards tree planting, forage crop production, erosion control, etc., to encourage acceptance of recommended practices.

The author comments that there seems good justification for further assistance to individual farms towards adopting conservation practices, many of which cannot be shown to increase immediate cash returns. Further emphasis and funds could accelerate desirable programs directed towards removing unsuitable land from cultivation. The impact of tremendous summerfallow acreage on conservation is noted with the statement that more research on various agricultural practices and their relation to soil and water losses is needed. The paper is concluded by emphasizing the increased significance of recreation and municipal requirements in terms of water resources and that a national conservation policy is needed.

HYDROLOGIC RESEARCH IN WESTERN CANADA

by
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The word hydrology would be properly defined as a study of the waters of the earth. This definition includes precipitation, surface and ground water, hydrology of lakes, rivers, and oceans, and the various processes common to each. Such a study, being tremendously broad, involves many fields such as meteorology, geology, and hydraulics. Use has established separate fields within the main grouping such as surface streams, ground water and the study of ice and snow. Unfortunately, a breakdown of this nature is not a practical one. The study of stream flow, for example, is intimately associated with a study of precipitation and geology. Studies within the hydrologic field are more logically grouped into uses of water such as irrigation, hydro-electric power, and urban and industrial water supply. These groups generally carry on their own hydrologic studies to meet their own specific needs. Because of the national aspect of the studies, Government Departments have taken on the major burden of supplying information necessary for the division of the limited water resources.

The study of Agricultural Hydrology must include studies made by groups for purposes other than agricultural and the ultimate objectives of these groups are not always in harmony. The power engineer, for example, requires maximum run-off for maximum power production, the flood control engineer requires steady flow maintenance, and the agricultural engineer prefers maximum retention on the watershed and minimum flow in the stream. Fortunately, the supply of water for agricultural purposes is almost adequate for present needs. This position cannot be maintained for long. An interesting report of the Hydrometric Service for the year 1910 had this to say in connection with a study of the Bow River in Alberta: "A study of the flow of the river indicates that the whole of the normal flow has already been granted for irrigation purposes". Subsequent water development on the river had to rely on storage of flood flow. The need for hydrologic study of river flow and surface run-off is therefore apparent. Further allocation of water rights on this river had to depend on estimates of potential peak flow. This, then, is the main job of the hydrologist, and a more realistic definition of the term might be "the estimation, measurement, and forecasting of the potential water supply."

The need for conservation only becomes apparent when the demand for water exceeds the supply, a fact learned too late in many areas of the world. This progression of events leads inevitably to the measurement and study of existing water supply and its allocation to users, which in turn places demands on research for forecasting techniques when supplies begin to dwindle. Basically, the needs of a sound water program are three-fold:

(1) An inventory of resources, constantly maintained.

(2) Control or mnaagement of the resource to ensure maximum benefit to the maximum number of people.

(3) Conservation of the water supply.

Hydrometric Service

An inventory of the water resource is maintained by the Hydrometric Service of the Water Resources Branch, Department of Northern Affairs and National Resources. Stream flow measurements were initiated in the prairie provinces in 1894 by the Department of the Interior. The program continued since that time under various Departments of the Government of Canada. Work was performed initially to determine the irrigation and water power potential of the rivers in the prairie provinces. Sixty-eight gauging stations were operated in this area in 1910. The program has expanded to include approximately 270 stream gauge stations with additional studies being conducted on water supply, drainage, navigation, and international waterway problems.

The Water Resources Branch conducts a systematic hydrometric survey program across Canada, studies and analysis of water supply problems are made and legislation pertaining to international rivers, water power, and water conservation are administered. In addition, a meter rating and experiment station is maintained at Calgary. Its principal duties are instrument calibration, investigation of new instruments, and the development of techniques for stream flow measurement. Results of stream gauging are disseminated through water resource papers. Additional reports are made periodically as the need demands. Flood potential, flood warning and low flow warning systems are maintained for immediate report to the areas affected.

Recently some new techniques and equipment significant to the Agricultural field have been introduced into the hydrometric program. Most important of these are the evaporation and precipitation measurements being taken in conjunction with stream flow data.

P. F. R. A.

Management of the water resource in the Agricultural field is largely the responsibility of P.F.R.A. One of the main functions of this organization has been to assist prairie farmers in establishing a reliable water supply for irrigation, domestic and livestock purposes. These projects include dams, dugouts, and irrigation systems. As the number and size of these projects increase, economical and safe design become of primary importance. Reliable prediction of available water and flood flow is therefore necessary to the success of this program.

The Prairie Provinces Water Board was formed to study and recommend the use and allocation of prairie waters. The board consists of representatives from the three provinces and the Government of Canada. The board does not carry on studies of its own, but can recommend that certain studies be made.

In order to develop the water supply program, P.F.R.A. established an Hydrology Division in 1952 to provide basic hydrologic information for planning and design. Studies were made of existing and proposed projects to ensure that an adequate supply of water was available and to provide data for design. Results of these studies are generally referred to the Design Division for incorporation into structures. To adequately fulfill this function the Division found it necessary to do a certain amount of basic work, much of which might be classified as applied research.

Specific jobs undertaken by the Division include, flood frequency analysis for specific areas, drainage area relationships to flood flow, and several regional run-off studies. Hydrometric coverage is provided for areas of specific interest and several snow courses are being observed and correlations made with the resulting run-off from these areas. The relation of snow depth and density has been quite successfuly correlated with depth of run-off water. The services of the Division are also available to other organizations with hydrometric problems.

Experimental Farms

The Experimental Farms have conducted research in water conservation and use practice throughout the entire area. Improvement of pasture and hay land through utilization of run-off water was the first of a series of these projects. These are generally small projects, the largest ranging up to about 150 acres, and were designed generally for the individual farmer. Early in the history of these projects it became obvious that existing stream flow data was not satisfactory for the design of small projects. Inadequate information on surface run-off on which to base design accounted for a fairly high mortality rate through lack of water in many cases and floods and wash-outs in others. These have provided some very useful information, however, on the handling of run-off water in small flooding projects.

Projects have been set up to measure average, peak flow, and peak rates of run-off from small watersheds. Two such projects are presently in operation. These were set up partly as pilot projects to study methods, structures, and equipment for satisfactory flow measurement. Since the greatest portion of the annual flow occurs as snow melts, one of the biggest jobs has been the design of equipment that will operate at below freezing temperatures. This part of the project has been completed. The question of run-off estimation, however, is one that requires several years of records before satisfactory analysis can be made. The projects are to be continued and expanded where possible to provide comparisons of run-off from watersheds of various sizes, topographic and soil conditions and meteorological differences.

Provincial Governments and Universities

Hydrologic work by the Provinces has been confined to development of water resources and the conservation of water. Some studies have been made on irrigation development and water erosion control. A study has been made by the Soils Department, University of Alberta, on the correlation between surface run-off and various crop covers and rainfall intensities.

Present Status

There is a very great need in the Agricultural field for more hydrologic information. The work presently being conducted is a process of doing the work as the need arises, a very unsatisfactory and, in some cases, dangerous practice in the field of water manipulation.

The next step is therefore one of increasing staff and facilities. There is no question of the economics of an increased hydrologic program. However, public awareness is the criterion upon which financial support for such a program must rest. The awakening of public interest must be first accomplished on the watershed which means the farmer must be encouraged to use water conservation measures. He must, of course, be shown the

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APPENDIX C

Capital Cost

Auger bunk feeder	$1,427.50
Unloading wagon system	583.00
Hand feed cart system	423.00

Operating Cost Per year

Auger bunk feeder	7.50
Unloading wagon	24.00
Feed Cart	0.00

1.) Pay-off period for auger vs. unloading wagon:

$$\frac{(1427.50 - 583.00)}{(24.00 - 7.50)} = 57.5 \text{ years}$$

2.) Hand cart vs. onloading wagon

The hand cart system, having both a lower first cost and operating cost, is clearly indicated as the best selection.

APPENDIX D

Capital Cost

Self feeder	
Modifications to 3 existing portable granaries	$ 300.00
Feed cart system (Appendix C)	423.00
Net capital cost favoring self feeder	123.00

Yearly Feed Costs

Limited feeding system	
Grain (Appendix B)	3,865.00
Roughage 112 Tons at $17.50/Ton	1,960.00
	$5,825.00
Self feeding system	
Grain (Appendix B)	4,625.00
Roughage 82 Tons (1) at $17.50/Ton	1,435.00
	$6,060.00
Net feed cost favoring limited feeding	235.00

Pay-off period $\frac{123}{235} = \frac{1}{2}$ year

For additional comparisons:

1.) for unloading wagon

Pay-off period =

$$\frac{(583 - 300)}{(235 - 24)} = 1.35 \text{ years}$$

2.) for auger bunk feeder

Pay-off period =

$$\frac{(1,427.50 - 300)}{(235 - 7.50)} = 4.95 \text{ years}$$

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economic advantage of such a program. If the economics are not favorable, then inducements must be added, possibly through construction or financial aid. This is another portion of the program that will require a great number of years to accomplish.

Research activities must keep abreast or ahead of watershed development work. The development of techniques and methods and the compilation and analysis of research information will need priority in an adequate program of water use and conservation.

Experience has shown that there are two distinct phases to a water development program, the engineering and the agronomic which must be brought together. It is virtually impossible to deal with watershed development or with research in hydrology solely in terms of one or the other. Close co-operation is required to develop to the fullest the potentials of any watershed. Satisfactorily designed structures are but half the job, compatable crops and cropping practices are necessary to complete the picture. It is only through such co-operation that the project economics can become favorable.

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