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Irrigation and Drainage Problems in Uruguay

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IRRIGATION AND DRAINAGE PROBLEMS IN URUGUAY[a]

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SYNOPSIS

Uruguay irrigates about 65,000 acres, mostly rice (74%) and sugar cane (15%). Summer rainfall averages about 3.5 in. per month, but frequent droughts seriously affect both crops and livestock. Irrigation can be increased by storage in small reservoirs on tributary streams by means of low earth dams. Some areas will require flood control and drainage before intensive agriculture can be practiced.

INTRODUCTION

During the period from July 1, 1957, to September 15, 1957, the writer visited Uruguay as a consultant for the Food and Agriculture Organization of the United Nations, for the purpose of advising on water resource development for irrigation. The specific purpose of the trip was to review plans for proposed irrigation projects, and to make general recommendations regarding the development of the water resources of the country for irrigation. During a 10-week period, seven field trips were made to various sections of the country to observe conditions and to see the irrigation systems. Since this was during the winter months in Uruguay, none of the irrigation systems were in operation.

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GENERAL DESCRIPTION

Geography.—Uruguay is located toward the southern part of South America between latitudes 30° and 35° south, corresponding approximately to that of Arizona. It is bounded on the north and northeast by Brazil, on the west by Argentina, with the Rio Uruguay separating the countries, on the southwest by the Rio de la Plata, and on the southeast by the Atlantic Ocean (Fig. 1). The total area is 72,172 sq miles, approximately the size of North Dakota. Although the smallest of the South American countries, Uruguay is larger than the combined area of Denmark, Holland, Belgium, Switzerland, and Albania.

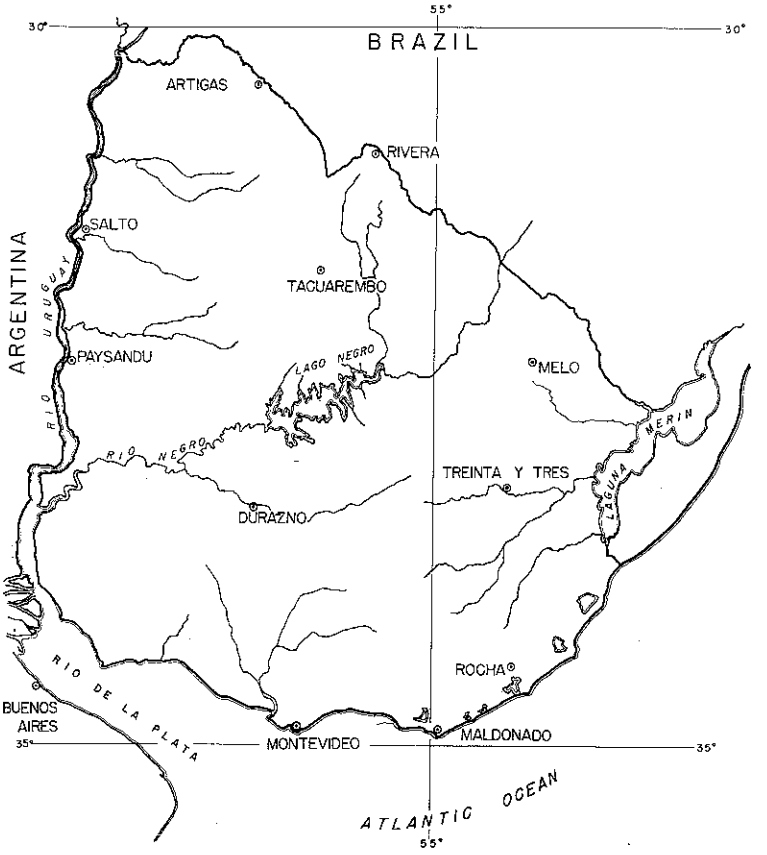

FIG. 1.—URUGUAY

The population of Uruguay, in 1957, was a little more than 2,500,000 according to official estimates. About one third of the people live in the capitol city of Montevideo. Uruguay has the highest density of population of any country in South America and is often considered the most progressive. The people are mostly of Spanish, Italian, and French extraction. There are very few Negroes, Indians, or persons of mixed blood. In both area and population, Uruguay is about the size of the State of Washington.

Topography and Vegetation.—Topographically the country is a continuation of the plateau system of southern Brazil with elevations rising to about 1,000 ft above sea level in the north central part. There are some small mountains in the southeast with a peak rising to nearly 2,000 ft.

Most of the country is an undulating grassy plain, almost treeless except for planted varieties, and some native species that grow along stream channels. There are two varieties of native palms in eastern Uruguay and another in the northwest which are protected by law. In recent years Eucalyptus trees have been extensively planted for shade, windbreaks, and fuel supply. A typical view of the Uruguayan prairie showing a stock-watering pool is shown in Fig. 2.

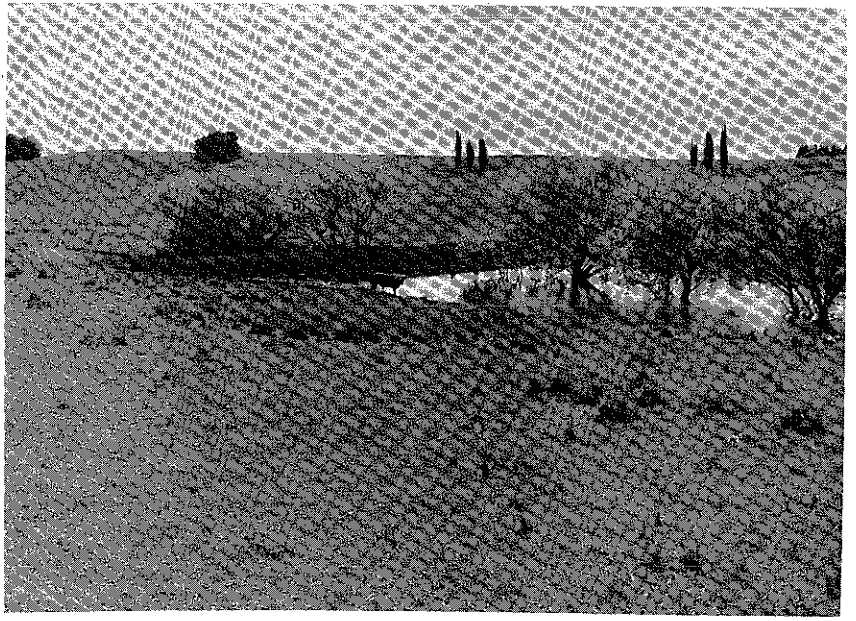

FIG. 2.—STOCK-WATERING POND, PLAINS OF URUGUAY

There is one large low-lying plain in eastern Uruguay, bordering the Laguna Merin, and a narrower coastal plain and lake area along the Atlantic Ocean and Rio de la Plata. The northwest part drains directly into the Rio Uruguay on the west. Most of the central part extending into Brazil on the north drains into the Rio Negro, a tributary of the Rio Uruguay near its mouth. The south and eastern portions drain into the Rio de la Plata, the Atlantic Ocean, or the Laguna Merin. The large low-lying plain in the east, and the southeast coastal plains contain large swampy and marshy areas and are in need of drainage and flood protection.

Climate.—The climate of Uruguay may be described as sub-tropical with extremes of temperature ranging from just below freezing in the winter to above 100 F. inland in the summer. The average annual rainfall for the country is about 42 in., varying from about 37 in. at Montevideo to about 48 in. in the northwest corner. The rainfall is well distributed throughout the year with

an average maximum of about 4.5 in. in March and an average minimum of 2.8 in. in July. At Montevideo the averate monthly rainfall varies from about 2.6 in. in February, July, and October, to 3.8 in. in March and April.

At first it would appear that the rainfall would be adequate for most crops and that irrigation might not be justified. A more detailed study of the rainfall, however, reveals that prolonged droughts are of frequent occurrence, especially in the hot summer months. Summer storms, in general, are of high intensity, with single storms exceeding 5 in. a fairly common occurrence. On occasion, more than 15 in. of rain has fallen in a 30-day period. This results in considerable runoff, and severe soil erosion where the land is cultivated.

Unusually heavy rains and floods occurred during 1959. The rains began on April 8, and during the next 15 days some parts of the country received more than the normal annual rainfall. At Tacuarembo, in north central Uruguay, the total rainfall for April was about 47 in. At Montevideo, the April rainfall was 19.7 in., or more than five times the normal for the month. The total rainfall at Montevideo, between December 1, 1958, and October 31, 1959, was 68.3 in.

The unusual April storms did a tremendous amount of damage, isolating many cities and ranches in the country. The large hydroelectric development on the Rio Negro at Rincon del Bonete was flooded and put out of commission for several months.

IRRIGATION DEVELOPMENT

Agriculture and Livestock.—Livestock production is the principal industry. The 1956 agricultural census[2] showed that nearly 34,000,000 acres were in natural pasture, with less than 5,000,000 acres in agricultural crops. This census listed 7,433,000 cattle, and 23,300,000 sheep. Wool ranks first, and beef second as the principal agricultural products and along with hides, accounts for most of the exports. The principal agricultural crops in 1951 and 1956 are given in Table 1. The extent and growth of irrigation during this 5-yr period is shown in Table 2. Rice is the principal irrigated crop, accounting for 74% of the total irrigated area, and sugar cane is second with 15%.

The irrigated areas are largely in the northwest, near the Rio Uruguay, where both rice and sugar cane are grown, in the eastern zone, where rice predominates, and in the south, where vegetables and fruits are the principal irrigated crops.

Present Irrigation Practices.—Nearly all of the irrigation, at present (1960), is the result of private enterprise, mostly by individuals who pump water directly from perennial streams or lakes and irrigate adjacent lands. Most of the rice growers farm large holdings ranging from several hundred to thousands of acres. Rice growing is highly mechanized. The land is plowed with tractors, levees are constructed with machinery, and the harvesting is done with combines. Since harvesting is done during the season of heaviest rainfall, rice must be artifically dried before being stored or milled. Rice growing, therefore, necessitates a very large investment in an irrigation system, tractors and machinery, and rice driers. Rice can be successfully grown on the same land only 2 yr or 3 yr before yields decline seriously. The common practice is to grow two or three crops of rice, then pasture the land from 3 yr

2 "General Agricultural Census," Ministry of Agriculture and Livestock, 1956. All figures have been converted from metric units and rounded.

to 5 yr before growing the next crop of rice. This, of course, requires the construction of an irrigation system for an area about three times as large as is irrigated each year. One plantation is experimenting with irrigated pastures in rotation with rice.

Sugar cane is grown in rows and irrigated by broad furrows. It can be grown on land that is more rolling than that suitable for rice.

There is a small government-sponsored irrigation project in southeastern Uruguay. Here water is diverted by gravity from a small stream at the mouth

TABLE 1.—AREAS IN PRINCIPAL CROPS

Crops	Thousands of Acres	
	1951	1956
(1)	(2)	(3)
Wheat	1,210	1,950
Forage crops	1,200	1,150
Corn	870	800
Sunflowers	470	450
Other cereals & flax	430	330
Fruit trees & vines	136	136
Vegetables	146	120
Rice	31.3	47.9
Sugar beets	7.8	19.3
Sugar cane	4.4	10.0

TABLE 2.—IRRIGATION DEVELOPMENT, 1951-1956[a]

Crop	Census		Change 1951-56,	Irrigated area in crop, in %		Crop area irrigated, in %	
	1951, acres	1956, acres	acres	1951	1956	1951	1956
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rice	30,300	47,200	16,900	75.9	73.5	100	99
Sugar cane	4,300	9,900	5,600	10.8	15.4	98	99
Vegetables	3,500	4,900	1,400	8.8	7.6	2.4	4.1
Fruit trees	800	900	100	2.0	1.4	-	1.0
Forage	230	680	450	0.6	1.1	0.02	0.06
Vines	170	110	- 60	0.4	0.2	-	0.02
Other	600	510	- 90	1.5	0.8	-	-
Total	39,900	64,200	24,300	100	100	-	-

[a] All figures have been converted from metric units and rounded.

of a canyon and conveyed several miles in an unlined canal to irrigate about 1,100 acres, most of which was in a single holding planted to apples. In spite of a water-charge schedule favoring small holdings, difficulty has been experienced in getting some of the farmers, for whom the water supply was intended, to use the water.

Why Irrigation is Not Extensively Practiced.—Assuming that the consumptive use for summer crops, under climatic conditions prevailing in Uruguay, would be in the range of 5 in. to 8 in. per month, it is apparent that irrigation would be beneficial for many crops now grown, and that it would make possible the production of crops not grown at present. Why, therefore, is irrigation not practiced to a greater extent? There are probably many reasons, some of which are:

1. A water supply is not readily available to most of the land area.
2. The topography of much of the land is such that water could not be easily applied by surface irrigation methods.
3. Most farmers have had no experience with irrigation. Research and extension work is necessary to promote irrigation.
4. The cost of pumping and other irrigation equipment, including sprinkling systems, is relatively high compared with the prices received for agricultural crops.
5. Livestock can be pastured the year around. There has been little incentive to grow crops, such as alfalfa, for winter feeding.
6. The development of irrigation for many crops commonly grown under irrigation in western United States is not warrented because of the relatively small population and present eating habits of the people.
7. Some areas, well suited for irrigation, need drainage and flood protection before they can be developed for intensive agriculture.
8. Transportation of produce has been a limitation in the past, but improved highways and use of modern trucks has opened up larger areas to crop production.

Reliability of Rainfall.—Since the need for irrigation of crops other than rice and sugar cane results from the frequent droughts and uncertainty of rainfall during the summer months, considerable attention was devoted to a study of the rainfall records for selected stations to determine their reliability. Thirteen stations, located roughly on two intersecting diagonal lines crossing the country, were selected for study. Eight of these stations were on a northwest-southeast line, and five on a southwest-northeast line. For each of these stations, the entire period of record was analyzed to determine for the 6 summer months of each year:

a. The mean monthly rainfall.
b. The median monthly rainfall, that is, that occurring 50% of the months of record.
c. The monthly rainfall occurring 5 yr out of every 6 yr, or 83% of the time.
d. The minimum monthly rainfall recorded during the period of record.

The results of this study are summarized briefly in Table 3.

Water Supply.—There are three possible sources of water supply for irrigation. These are:

1. From perennial streams or lakes.
2. From ground water development.
3. From storage of runoff in reservoirs.

All of these sources are being given careful consideration by the government in connection with proposed irrigation developments. In places where water supplies are available from perennial streams, such as the Rio Uruguay,

direct diversion, usually by pumping, offers the most economical solution. The total area that can be irrigated from such sources is limited to areas near sources of supply where pumping lifts are not excessive.

Most of the smaller streams in the country are dry, or nearly so, during the drought periods when irrigation is needed. Any extensive development by diversion from the Rio Negro or its tributaries, except in the lower reaches, would interfere with the present and proposed hydroelectric development, and the question of water rights would have to be resolved.

There is also a question as to the desirability of further development by direct pumping from Laguna Merin, or its tributaries, as the water level in the Lake becomes very low during drought periods, and salt water flows back into the Lake from the Atlantic Ocean. A control of the outlet could remedy this difficulty, but the outlet channel, the Rio Gonzalo, is entirely in Brazil.

Ground water development does not appear promising. An investigation of ground-water supplies has been made by government agencies. Because of the nature of the geologic formation over most of the country, yields from

TABLE 3.—SUMMARY OF RAINFALL DATA

Month (1)	Mean rainfall, in inches (2)	Median percentage of mean (3)	83 Percentile percentage of mean (4)	Minimum percentage of mean (5)
October	3.5	86	46	29
November	2.8	86	47	27
December	3.0	72	33	13
January	3.9	88	37	13
February	3.5	90	47	19
March	5.0	89	51	28
6-month period	21.7	85	43	22

wells are not adequate to make such supplies economical for irrigation. Only in the alluvial areas are yields sufficient to justify ground-water development for irrigation. Excellent wells have been developed in one alluvial area near the Rio Santa Lucia northwest of Montevideo.

Storage of runoff, in relatively small reservoirs on many of the smaller tributary streams, would appear to offer possibilities. There are probably few good sites for large reservoirs, and the construction of adequate spillways to carry the flood flows on the larger streams would be very expensive. It is believed that low earth-fill dams could be constructed on many small streams at a fairly reasonable cost, and that considerable development could result from such a program. One such reservoir has been constructed near Rio Branco, in the northeast, and it is understood that there is another one in the north central part. Detailed investigation of possible dam sites would have to be made to determine the economics of this kind of development.

Stream-flow records are available on very few streams. Records at the hydroelectric power plant at Rincon del Boneta on the Rio Negro in central Uruguay indicate that 38% of the estimated total rainfall on the watershed ran

off. This is probably a higher percentage than could be depended on for a water supply, but because of the nature of the storms and soils, there is considerable runoff which might be stored for irrigation. Research is needed to establish relations between rainfall and runoff from which reliable estimates of available supplies for storage could be made.

Drainage and Flood Protection.--As previously mentioned, some areas otherwise very suitable for irrigation development need drainage and flood protection before they can be used for intensive agriculture. The so-called "Eastern Swamplands" has been under investigation by the government for many years, but financing has not been available for development. This area contains more than 1,500,000 acres of flat land, much of which is flooded during the fall and winter months. The proposed project would reclain about 1,000,000 acres in three stages.

Stage one would include the drainage and flood control canals and levees to prevent flooding of the area, and to convey the flood waters to the Laguna Merin.

Stage two would consist of four reservoirs, one on each of the principal rivers flowing into the area.

Stage three would consist of the construction of a hydroelectric plant at the major dam, and the irrigation works to serve the area. The total cost, as estimated in 1955, was the equivalent of about $25,000,000.

A much smaller, but somewhat similar, area in the southwest was being reclaimed by an individual who was planting the area to trees for the development of a pulpwood industry. At the time of the visit, about 4,000 acres had been drained and planted. It appeared that with flood protection, drainage, and irrigation the soils would be suitable for many agricultural crops.

The heavy storms and floods of April, 1959, amply demonstrate the need for flood protection in connection with irrigation and drainage developments. Severe flood damage occurred in many parts of the country that were not normally subject to flooding.

CONCLUSIONS

Some of the conclusions arrived at as a result of the studies were:

1. Irrigation would be beneficial for most summer crops and, also, for pastures.
2. Research should be conducted to determine the economic aspects of irrigation agriculture.
3. Basic policies that would provide a guide for the future development of the water resources of the country should be formulated.
4. Although the present development has been carried out mostly by individuals, future developments will depend more and more on government sponsorship.
5. Meteorological records are quite adequate, and the present topographical survey is progressing satisfactorily, but little has been done to provide stream flow data essential to the planning of irrigation projects.
6. Financing the proposed projects is a major obstacle to development.

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