INTERNATIONAL
JOURNAL OF
AGRARIAN AFFAIRS
Vol. II, No. 6, July 1960

The Economics of Water Supply and Control:

Jordan
Iran
Peru
Poland

Price 5s. 0d. net
OXFORD UNIVERSITY PRESS
LONDON

By A. AZARNIA

Ministry of Agriculture, Tehran

IRRIGATION WATER DISTRIBUTION IN IRAN

BECAUSE of the low rate and irregularity of precipitation and because of the vast areas of desert lands, water is very precious to the Iranian people. Except for the Caspian and Elburz Mountain area, there are few places which depend entirely on rainfall for farm production. In some areas in the central part of the country no production at all is possible without irrigation. People there depend entirely on water for gaining a livelihood. Therefore, these people, from experience over many years, have learned much about the use of water for both irrigation and power.

From the remains of ancient dams on the Karun and Dez in the Khuzistan, from the evidences of ancient irrigation operation in Fars and Khorassan and from the diversion and dams in the Zayandeh-Rud area of Isfahan, we are able to gather much of the knowledge of earlier Iranians about methods of irrigation.

Because of the very great need for water in the desert areas, there has been continual effort to find the best ways of using underground water for irrigation.

The Karun and its waterfalls

In olden times when there were no water pumps or other mechanical equipment, the early Iranians dug tunnels of varying lengths (called ghanats) into the hillsides and brought the underground water to the surface.

During the past thirty years much has been done in the way of using river water for irrigation. For example, the Kuhrang Dam and tunnel, the Shabankareh Dam, tunnel and irrigation structures at Behbehan and Kazerun, and the use of underground water in the Jahrome area.

Because of the great value of water and the difficulties of obtaining agreement amongst farmers, laws have been passed for dividing the water from the rivers and ghanats. These laws vary from one part of the country to another, and only a summary of the methods of dividing irrigation water is discussed here.

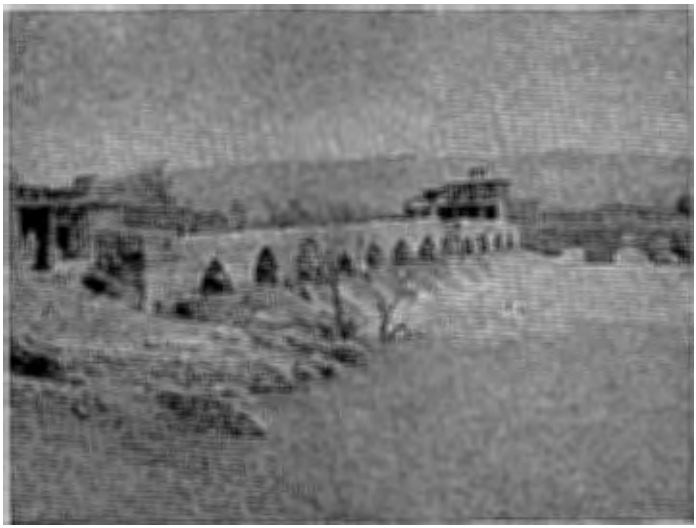

FIG. 1. Band-Amier, about 47 kilometres from Shiraz, was repaired and reconstructed during the reign of Azodd'deddoleh Deilami, about 900 years ago.

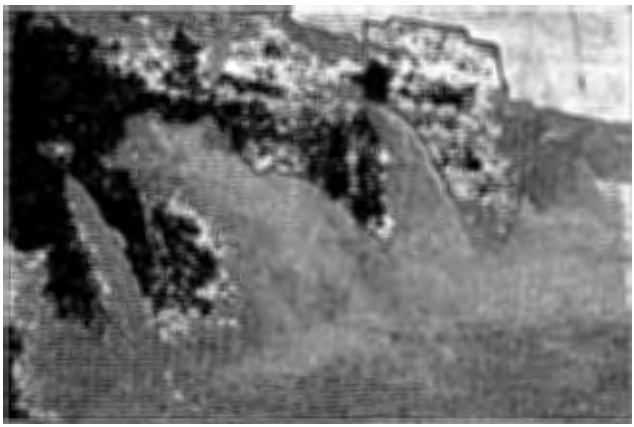

FIG. 2. Remains of the Shushtar Dam on the Karun River.

Methods of dividing water from rivers and ghanats

From ancient times the government has controlled the division of water from the rivers and large springs and has allotted supplies to each of the villages in a given area. Only when an owner of a village can show that a part of the water being received is surplus to the needs of the people of that village can he sell the water for use in another village. *Bongah Abyari* is the government agency that is responsible for administering this programme.

River water is divided by one of three methods: (1) with continuous flow; (2) with rotation of flow; and (3) according to the demand of the farmers.

1. Division of water with continuous flow is the most common method and is applied to the Rivers Karadj, Jadjrud, Hablehrud and Kardan. It may be considered in two parts:

(*a*) *Division according to fixed amounts.* Because there is insufficient water to irrigate all the available land, the governing authorities have long been responsible for distributing the limited amounts amongst the various villages in each season. The unit of measurement commonly used in these allotments is the Sang. On the Karadj, Jadjrud and Kardan rivers, 1 sang is about 10 litres per second. In this method of division according to fixed amounts, the number of sang allotted to a village is the amount that village is to have so long as total supplies are adequate. If the total river flow becomes less than the total number of sang allotted, each allocation is reduced proportionately.

In earlier times reservoir dams had not been constructed, and although much water was needed in the springtime when the farmers were planting and irrigating their crops, the rivers were generally higher at that time of year and were often in flood, thus providing large amounts for irrigation. This is why the governing authorities divided the water in fixed amounts which were different in the different seasons according to the amount of water needed and the amount of water available.

(*b*) *Division according to the varying amounts of water in the river.* In some of the rivers, as on the Golpayegan and Nahavand, the total river water is divided into shares and the flow to each village is continuous. For example, the Haroon Canal, which takes water to some fifteen villages, is divided into thirty-three shares. Each village owns a definite number of the shares and receives water accordingly. On rivers and large canals where water is divided according to shares of

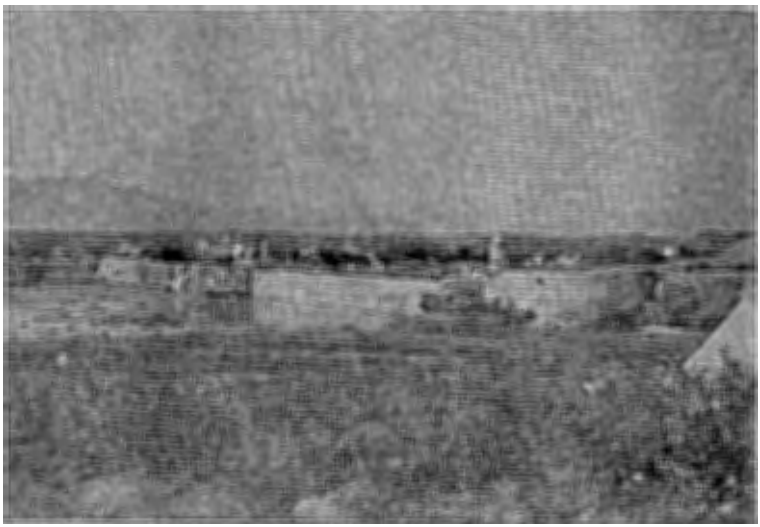

FIG. 3. The Marvan Dam on the Zayandeh-Rud divides the water between the upper and lower parts of the Rudashtin area.

FIG. 4. The Kuhrang Dam, on one of the branches of the Karun.

the total, dams and other arrangements for diversion are sometimes made so as to allow only the correct proportion to be diverted to each location. The work of the 'water-tender' is commonly limited to these major diversions, seeing that no stones, wood, movement of earth, or other objects interfere with the proper division. This work of the government representative usually extends only to divisions between villages. Within the villages the farmers have their own organizations and divide the water among themselves.

2. *Division of water according to rotation of flow*

When crops are irrigated water is absorbed by the soil and stored among the soil particles. The plant roots take water over a period of several days from this storage before irrigation is again needed. The length of time needed between irrigations varies with location, soil and kind of crop. But within a single area where water is divided by rotation of flow, the length of time between rotations of the water is a fixed number of days, normally the period between irrigations that most of the crops will stand without serious injury. For example, on the Marzdaghan River the length of the rotation is eleven days. On the first six days the water is used in the villages along the upper part of the river. On the seventh day the water is diverted to the villages of the lower area to which it flows for the remainder of the period.

Within a village the water is commonly divided into 72 *habeh*. The village watermaster calculates the number of hours' flow to reach his village, and divides this length of time among the farmers of the village according to the number of *habeh* owned by each. During periods of extremely low flow two or three villages may combine their shares in order to obtain larger heads, faster flow and smaller losses. They then divide the larger amounts among the villages according to the share owned by each, with each receiving the water for a proportionately shorter time.

In some areas where the total flow is rotated, division is made according to day and night. For example, in autumn and in spring the water of the Khonsar spring is used during the day in the area near the spring. Then from 6 p.m. to 6 a.m. the intakes are closed and all the water continues down the stream where it reaches the village of Nian during the next day for irrigation in that part of the area.

The method of division by shares was used in olden times on the Zayandeh-Rud River, and the following statement may give some further insight into earlier use of the method.

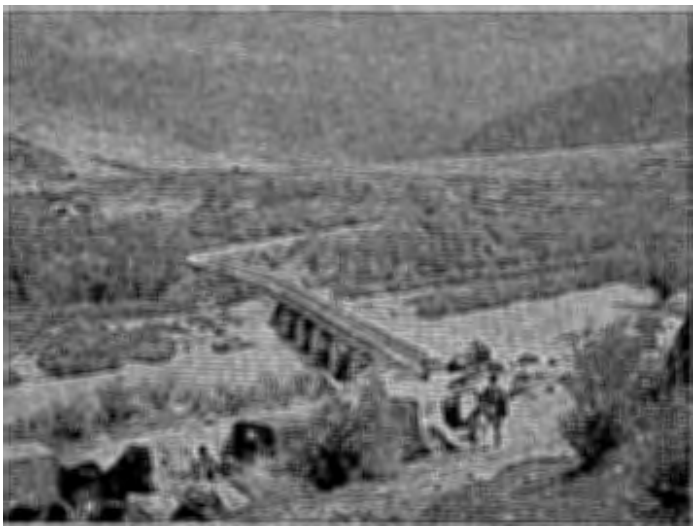

FIG. 5. Inverted siphon and mouth of tunnel 'Kazerun'.

FIG. 6. Palm groves and citrus gardens in the Jahrome area, where water is pumped from wells by electric-motors.

System of distribution of water of Zayandeh-Rud River of Isfahan according to Sheikh Bahaee

This system was established 1,500 years ago and was amended by Sheikh Bahaee (a mathematician) 300 years ago. It is a combination of continuous flow and rotation of irrigation. The determining factors are length of time, quantity of flow, weather and agricultural conditions of each area under irrigation. The calendar year was considered to

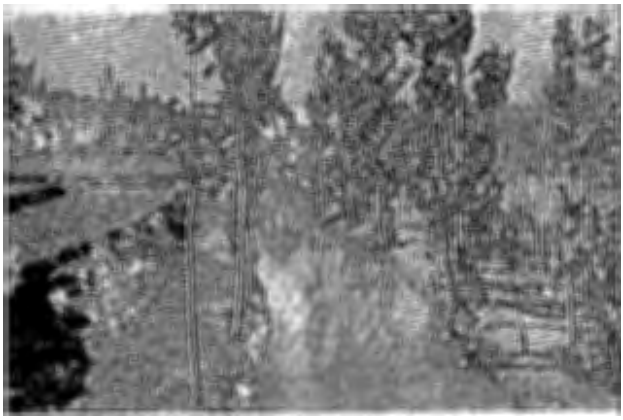

FIG. 7

be 360 days. During a period of 195 days, from 22 November to 5 June, the river is usually in flood, and there is then more water available than is needed. During this time it can be used freely. During the dry years this arrangement is altered and the water is distributed by a committee formed of heads of villages and landowners.

During the remaining 165 days of the year (i.e. from 5 June to 22 November) the river water is divided into thirty-three shares each of five days.

The lands situated at the downstream end of the river have 6 shares, i.e. 30 days of flow, 15 days from 6 June to 21 June, and 15 days from 6 November to 21 November. These periods coincide with the sowing season in this region and the irrigation of wheat and seed products. During the remaining 135 days (i.e. from 22 June to 6 November) the water is divided into 27 shares: Lenjan being given 10 shares; Alanjan 7 shares; Jee 4 shares; and Marbeen 6 shares.

In order that water may be distributed regularly and be useful for agriculture, these four regions have made an arrangement amongst

themselves, which locally is called *Vonesh*. They are divided into two groups—Lenjan and Alanjan with 17 shares, and Jee and Marbeen with 10 shares.

In the meantime, as the Lenjan region is far from the river so that the water reaches it late, and Jee and Marbeen are still farther, one additional day's flow is given to the first group and two additional days' flow to the second group.

The water in the Zayandeh-Rud from 22 June is divided in the proportion of nine days to six days between the Lenjan–Alanjan and Jee–Marbeen regions, i.e. the water is run into Lenjan and Alanjan (nine days) and Jee and Marbeen (six days) alternately for a period of three months.

This system is continued until 23 September. From then until 10 October the water is used for irrigation of grass crops, Alanjan and Lenjan receiving eleven days' flow and Jee and Marbeen seven days', alternately.

From 10 October until 6 November, which is the planting period for cereal crops, the water is distributed according to the shares. When the water is low it is divided according to the following arrangement: Alanjan 4 days; Lenjan 6 days; Marbeen 4 days; Jee 6 days; Gowarej 3 days; Bara-an 4 days; giving a cycle of 27 days.

3. *Distribution of water by demand*

This system is carried out in areas where the water is obtained by pumping from shallow or deep wells. The water is paid for in litres per second or per hour of flow, or according to the area under irrigation. Each farmer or landowner who needs water applies to the water agent, pays for the water he needs and the water is delivered to his land.

In the rivers where a part of the water is not yet committed to farmers or landowners, the water is sold to the latter, and the river administration concerned collects payment for it. The water is sold under the following conditions:

1. The buyer presents his request to the river administration 24 hours before the water is needed.
2. The minimum quantity of water which can be sold for each irrigation is 25 litres a second for a period of 12 hours.
3. The price of the water is calculated on the basis of 50 litres a second for a period of 24 hours, and the rate changes according to the time of year when it is purchased.

APPENDIX

Some physical and agricultural data

1.	Total area of country	164,000,000 hectares
2.	Area of the northern forests	3,500,000 ,,
3.	Area of the Zagros ranges and southern forests	15,500,000 ,,
	Total area of forests	19,000,000 ,,
4.	Cultivable area	33,000,000 ,,
5.	Area under cultivation and fallow, approximately	17,000,000 ,,
6.	Area under cultivation per year	5,000,000 ,,
7.	Area under irrigation per year	1,700,000 ,,
8.	Area under dry farming	3,300,000 ,,
9.	Free pastures	12,000,000 ,,
10.	Pastures in the forests	5,000,000 ,,
11.	Average quantity of water/sec. over the whole country (approx.)	3,000–3,500 cubic m.
12.	Quantity of water/sec. in ghanats (underground water over whole country)	550–560 cubic m./sec.

13. Precipitation:

Maximum—2,000 mm./year (Bakhtiari, *Tavalesh, Fumenat, on the Caspian Sea*)

Minimum—18–35 mm./year (Sistan and part of the desert)

14. Temperature:

Minimum—25–28° C. below zero (Bakhtiari, part of Azarbayejan and Kordestan)

Maximum—55° C. above zero (Bampour, Iranshahr, Abadan and Abbass)