ECONOMIC REPORT ON CULTIVATION IN THE REGION OF THE SIXTH PROVINCE (DISTRICT 2) INCLUDING THE TOWNSHIPS OF BOROOJERD, GOLPAYEGAN, KHORRAMABAD AND ALIGOODARZ

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Subject. We have so far studied the cultivated area, crops produced, estimates of agricultural income, and changes in the farmers' income from the year 1926 to 1960; examined the factors that have caused these changes, and compared the farmers' standard of living in this region with that in other regions of the country.

Study Programme. The study has been carried out, and the results have been presented, according to production factors in the following parts:

Part I. Situation, boundaries, and the area of the region under consideration.

Part II. Administrative divisions of the district at various times of survey, and parity of statistical areas with those of 1960 for comparative purposes.

Part III. The climatic factor.

Part IV. The soil factor.

Part V. The water factor: determination of the various sources of water; the quantity of water consumption per hectare of various types of cultivations during one sowing- to- harvesting cycle; yield of crops irrigated by one cubic meter of water; the value in rials of each type of cultivation; water rights and the cost of supplying one cubic meter of water from rivers, qanats or wells; and a comparison of these parameters with identical quantities in other places already studied.

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Part VI. Distribution of crops between the farmer and owner up to the date of the enforcement of land reform.

Part VII. The labor and power factor: study of the farming population as a labor factor and the number of working oxen as the power factor; the area cultivated by a single ox (which is an agricultural production unit in Iran), and computation of production and its value for various types of cultivation; study of the relationship between: (a) changes in population and area under cereal cultivation, and (b) changes in the number of oxen and the cultivated area in district 2 of the province 6 during the last 35 years; as well as a comparison of these parameters in all the places already studied.

Part VIII. To compensate for the abolition of opium cultivation by extending autumn cultivation of crops such as wheat and barley.

Part IX. Combining various factors in the raising of agricultural products, study of the ratio of increase in the production of cereals to population growth; volume and cost of production of other crops and their 35 year changes; comparison of the cultivated area and production of wheat, barley and rice in this and other places studied, with the total area under cultivation and entire national production; computation of the following ratios:

$$\frac{\text{Production}}{\text{Cultivated area}}, \quad \frac{\text{Population}}{\text{Cultivated area}} \quad \text{and} \quad \frac{\text{Cost of production}}{\text{Cultivated area}}$$

In order to determine the region's inclination towards one of the two cultivation systems: « intensive» or « extensive» and classification of these in the corres - ponding table of the country's agricultural regions; study of the correlations between the agricultural population and the cultivated area and production, and finally, the compntation of per capita income earned from cultivation, alone and its comparison with identical per capita incomes obtained in other Provinces so far studied.

Sources. The statistics and sources used for this study are as follows:

1. Statistics of the Economic Department of the Ministry of Agriculture for the year 1957, which by means of questionnaires, determined the cultivated area and the yields of crops in all the villages of Iran.

These statistics in some instances, especially with regard to the yield of certain products, seem to be over- estimates.

Another part of these statistics, dealing with the price of agricultural products during the 1957- 1960 period and obtained from wholesale markets through weekly questionnaires, has been extracted and utilized by the members of the group.

2. National Agricultural statistics prepared in the year 1960 by the Public Statistics Department. These statistics were prepared for all parts of the country by means of questionnaires on the quantity of crops, and by the sampling method in the case of cultivated area and population. The total number of villages selected and used as samples by the Public Statistics Department in the cold region (district 2) of province 6, is 76. Out of this number, 69 villages have a population of less than 1000 households and the rest between 1000 and 10, 000. Hence, in view of the inadequate number of villages sampled, it is not possible to prepare separate figures for each township; if prepared, they will have many errors. For this reason we shall base our study and comparison only on the overall statistics of the cold region of province 6 which was mentioned as district 2 of this province in volume 8 of the Public Statistics Department's publication.

3. Statistics have been extracted by the members of the group from the tax- auditing documents in the archives of the Ministry of Finance, related to cultivated lands in the years 1926- 1933, which, as stated in the report on Isfahan and Yazd, (Quarterly Journal of Economic Research nos. 9 and 10), seem to be under- estimates.

4. Publication no. 3 of the Scientific Research Center for Arid Regions, entitled « Statistics on Precipitation in Iran »; and the publications of the Meteorological Department. dealing with weather- forecasts in district 2 of province 6.

5. «The Geographical Dictionary of Iran», volume 6, published by the Army Geographic Section.

6. «Geography and Village- names of Iran», volume 2 (province 5, 6,7, 8), published by the Civil Registration Department.

7. Statistics of the General Department of Agriculture for the year 1935,

arrived at by means of monthly enquiries made from provincial agricultural departments.

8. The map of administrative divisions of the country in 1960, as well as a map on the soils of Iran and a report on soil characteristics in the district under study, obtained from the Soil Technological Institute of the Ministry of Agriculture.

9. Published and unpublished reports and data from the Independent Irrigation Institute, including: The preliminary report on the irrigation and development project of the Boroojerd, Khorramabad and Tarhan plain, a report in English on « Utilization of water and land in the Golpayegan district», and another report on the quantity of water used for the irrigation of crops in the Isfahan province.

10. The Summary Report of the Dashte Gorgan Development Project published by the Water and Power Organization of the Sefid Rood region.

11. Data obtained from the Development, Irrigation and Agronomy teams of the Karadj Faculty of Agriculture and Peyvand Co. of Gorgan.

12. Statistics on the area under opium cultivation and its production and price between 1943 and 1955, from the ex- Opium Monopoly Depart - ment.

Part 1. Situation, Boundaries, Natural and Political Conditions and Area

The region under study, i.e., the cold region of province 6, is about 32951 sq. kilometers in area and includes the townships of Khorramabad, Boroojerd, Golpayegan and Aligoodarz; which, in volume 8 of the Agricultural Census publication of the year 1960, was called District 2 of province 6. This district, together with the townships of Dezful, Ahwaz, Shushtar, Masjed Soleiman, Khorramshahr, Abadan, Dashte Mishan, Behbehan, Kohkilooyeh and Ramhormoz, known as district 1, form the province 6.

The economic study of district 1 (Khuzistan) was conducted by this group, and published in issues nos. 3 and4 of theQuarterly Journal of Economic Research. In the present issue our study is confined to district 2.

This district is bound on the north by the townships of Mahallat Khomein, Arak, Malayer, Nahavand and Kermanshah; on the west by Ilam; on the south by Dezful, Izeh (Chahar Mahal Bakhtiyari) and Fereidan;and on the east by Najafabad and Isfahan.

From the standpoint of climate, the district is generally divided into two regions: (a) the cold region, including Golpayegan, Boroojerd, and Aligoodarz, with a part of Khorramabad; (b) the tropical region including the south and west of Khorramabad.

From the general standpoint of altitude, the Zagros, mountain range passes through Khorramabad, Boroojerd and Aligoodarz; and the central mountain range passes through Golpayegan in a north- west to south-east direction. The altitude of this district varies from 1,000 meters on the plains of Boroojerd, Khoramabad and Golpayegan, to over 3, ooo meters at the summits of the mountain ranges. Some of the mountains of this district are:

Garrou, Aleshtar, Sheikh Miri, Vanai and Tudezan in Boroojerd; Pishkooh Goroun, Puneh, Deymale, Sefidkooh and Beheshtkooh in Khorramabad; and Oshtorankooh and Qalikooh in Aligoodarz.

The major rivers of this district are:

1. **Khorramabad**. The Kashkan River, which is one of the three tributaries of the Karkheh; its source is in the Zardaloo mountain and it eventually joins the Korramabad river. The area watered by this river starts from the northern part of the Aleshtar Plain, and covers the whole of this plain as well as the districts between the city and Kahkan- Rood and the Koohdasht plain.

The Khorramabad River is part of the Kashkan river basin. It starts from the upper part of Khorramabad, and after irrigating the city, which is situated in a narrow valley between the mountains Koohsefid and Koohmakhmali flows into the vast plain.

2. **Boroojerd**. The Boroojerd River has its source in the north western highlands of the township of Boroojerd, and eventually joins the river Marbarreh near Dorood. It is variously called by such names as

Silakhor, Gelleh- Rood and Vanai. It has a permanent flow of water and its bed is lower than the surrounding lands.

The Bagheshah River, whose source is to be found in the heights of the Tudezan and Sheikh Mir mountains, irrigates some of the northern villages of the province.

The Qalch- Karam River, which rises in the upper Silakhor heights, irrigates some of the upper and lower Silakhor villages.

The Abdiz River, a main tributary of the Karoon, begins in western Boroojerd and flows towards the south.

3. **Aligoodarz.** The source of the Aligoodarz River is on Zazm mountain; it irrigates the Aligoodarz lands, but dries up in the summer.

4. **Golpayegan**. The Golpayegan or Qebleh River, which rises in the southern mountains of Khansar, and the Daie, Darband and Darrehderaz valleys, enters the central area of Golpayegan after passing the southern part of Khansar. This river, after passing Golpayegan, is known by the name « Lalbar». It passes through the Mahallat, Delijan and Qom townships, and in the east of the latter township, ends in Massileh. In recent years, a dam has been built across this river at the village of Deh Akhtekhan, which is of great importance in regulating the water of the river and preventing damage resulting from shortage of water in the dry seasons.

From the standpoint of political divisions, the cold region of province 6, in the administration divisions of the year 1960, contains four townships namely: Korramabad, Boroojerd, Golpayegan and Aligoodarz.

According to the summary report of the 1956 National Population Census of Iran, the area of this region is 32951 sq. km. which is divided as follows:

Township	Boroojerd	Golpayegan	Khorramabad	Aligoodarz	Total
Area in sq. km	2218	4172	17581	8980	32951

In order to study the changes in the area of the district from 1956 to 1960, accurate measurements were taken by planimeter from the map of administrative divisions, and the results are these:

Township	Boroojerd	Golpayegan	Khorramabad	Aligoodarz	Total
Area in sq. km.	2563	2147	21180	5938	31828

The comparison of the above two tables shows that the area of these townships has changed from 1956- 1960.

The reason for the decrease in the area of Golpayegan in the year 1960, as compared with 1956, is that in the 1960 divisions, 110 villages had been separated from the rural district of Hamzeloo, Dalaic, Kallehzan and Rastagh, to form the Khomain township. The reason for the increase in 1960 of the area of Khorramabad, is that part of the Ghilab rural district as well as the Mangareh, Khaleseh, Sigan, Darreh shahr and Majin, making a total of 100 villages, had been added to this township.

We could not find the reason for the differences in the areas of the Boroojerd and Aligoodarz townships in the years 1956- 1960. The difference may be attributed to errors in the map utilized in determining the boundaries of the 4 townships.

Part II. Political divisions of the cold region of province 6, determination of the changes in its boundaries during the various survey years, and the creation of a common area between the statistical area of former years and that of the year 1960.

In the administrative divisions of this region, as in the case of the other districts so far studied, certain changes have taken place, in the course of time and according to the sources preparing statistics, but these changes are comparatively limited. The sources whose statistics are utilized by us at various times have each based their work on the political divisions, existing at the time, and these divisions are in general different in area.

Therefore the comparison of agricultural statistics of various periods of time with the 1960 statistics necessitates parity between their statistical areas and that of the political divisions prevailing in 1960.

With a view to showing the differences existing in the political divisions at different times, we have drawn up table 1 (a. b. c. d.), which shows the political divisions and population separately for each one of the divisions used in compiling this report.

By comparing the different parts of the table we get the following results:

1. Aligoodarz, which in the division made by the Land Auditing Department in the years 1926 to 1933, as well as in the classification made by the Economic Department of the Ministry of Agriculture in the year 1957, was a rural district of the Boroojerd township; has, in the 1960 divisions made by the Public Statistics Department, been considered as a separate township.

2. The number of villages considered in the divisions of the year 1926 is about 100 less than that obtained by the Public Statistics Department in 1960. Although the difference in the number of villages between the two periods of 1926 and 1960 is relatively small, this does not imply the approximate parity between the 1926 and 1960 statistical areas; because the changes that have taken places in the district under study during the 35 years have caused a difference in production between the old and new statistical areas. We have, however, eliminated this difference by utilizing the method which will be explained later.

3. In the year 1960 about 300 villages have been included over and above those of the year 1957.

This difference arises from: (a) In the year 1960, the Darrehshahr rural district, with 48 villages, was considered a part of Khorramabad, whereas in the year 1957 this district was not included in Khorramabad; (b) In the 1957 survey carried out by the Ministry of Agriculture the farms attached to the villages were considered part of the villages, while in the year 1960 these farms were considered as independent units.

From the above, we come to the conclusion that the 1926 statistical area does tally with that of the year 1960, which has been based on the new divisions. In order to bring these two areas up to parity, we must adopt the method employed in other districts, i. e. calculate the coefficients of conversion of the old statistical areas into the new ones.

The district under study consists of 650 sample villages 1 as follows:

Aligoodarz	212	Sample villages	
Korramabad	241	»	»
Boroojerd	130	»	»
Golpayegan	67	»	»

In computing the coefficients we were confronted with two difficulties: (1) Out of the 212 villages of the Aligoodarz township, the statistics of the number of households of 148 villages only were found in the auditing of 1926- 1933. There were no villages in this township, the number of whose households and population might be known at that time, and on the basis of which we could estimate the number of persons in each household, and subsequently the population of the above mentioned 148 villages. (2) None of the villages of Khorramabad had statistics on population and households available, hence there was no way of computing the coefficients α and β for this township.

In order to overcome the first difficulty, we decided to estimate the size of household for the year 1926 for Aligoodarz by the following method: We selected some sample villages of the Golpayegan and Boroojerd townships and took the details of the number of households and population from the 1926 report; and, on the basis of these villages, we estimated the average size of household for 1926 in these two townships.

Then, by utilizing the statistics of population and households of the year 1956 of the sample villages, we computed the number of persons per household in that year for the townhips of Golpayegan, Boroojerd and Aligoodarz. The results of the said computation are shown in the following table.

As shown in this table, the increase in the size of household from 1926- 1933 up to 1956, in the two townships of Golpayegan and Boroojerd was almost equal, and an average of about one person (to be exact 0.95) was added per household. Therefore if we suppose that this change holds good also in the ease of The Aligoodarz[1] township, we shall arrive at the conclusion that the size of the household in the said township in 1926 must have been approximately $X = 3.85$. On this basis, the population of the sample villages of Aligoodraz, marked Y in the table, was estimated at 21402 ($Y = 3.85 \times 5559 = 21402$).

1. This assumption seems to be sound, as the townships of Golpayegan, Boroojerd and Aligoodarz, are almost homogeneous from a physical, agricultural and demographic view-point.

Township	The years 1926- 1933			The year 1956		
	Population	Houscholds	Size of each household	Population	Households	Size of each household
Golpayegan	19191	4962	3.8	40759	8466	4.5
Boroojerd	9287	2205	4.2	42078	8234	5.1
Aligoodarz	Y	5559	X	154425	32068	4.8

However, since there was no solution for the second difficulty, we were compelled to apply to the Khorramabad township the coefficient related to Golpayegan, Boroojerd and Aligoodarz.

The above coefficient should he multiplied by the statistical data of the years 1926- 1933 for the sample villages of each township, in order to obtain the data for that township over these seven years, according to the 1960 administrative divisions, as well as the data related to the district under study from the total statistical figures of the 4 townships:

In order to be brief we calculated the coefficients α and β and inserted them in Table 2, without giving further explanations.

It should be pointed out that the boundaries of the townships under study in this table tally with the 1960 administrative divisions, but the population figures used in computing the coefficients for later years are those for 1956 in the same townships. In Table 3A the Agricultural Census for the years 1926 to 1933 taken by the Lands' Auditing Department of the Ministry of Economy have been multiplied by the coefficient β and made at par with the census district of the year 1960 so that they could be compared with the 1957 census taken by the Ministry of Agriculture and that taken by the General Department of Public Statistics in the year 1960 which are inserted in Table 3B and 3C.

Explanatory Notes on Table 3

1. All population figures for the region exclude the population of the town of Boroojerd.

2. As the area under rice cultivation in the years 1926- 1933 was not known, a horizontal line was reserved for total amount of grains, excluding rice, in order to facilitate the comparison of the statistics of the said years with those of the recent years.

3. The prices of crops during the years 1926 - 1933 have been extracted from the Cultivated Lands Auditing Papers of the Ministry of Finance.

4. The prices for the years 1957 and 1960 were obtained from the Economic Department of the Ministry of Agriculture. But as the prices of some crops were not known and we could not get correct data from other sources such as the National Bank of Iran, Central Bank and the agricultural

departments of the four provinces under study, we were compelled to utilize for the 1957 estimates the prices of other irrigated cereals, vegetables and fodder plants; and for the 1960 statistics, the prices of other irrigated cereals, sugar-beet and fodder plants of the province of Isfahan, which was the nearest region to the one under study, the one possessing similar available data.

5. The price of tobacco in the years 1957 and 1960 was obtained from the Tobacco Monopoly Department and that of sugar- beet in 1957 from the book « Research on the History of the Sugar Industry in Iran» by Eng. Riahi.

6. The yield of rice has been given under the title of « Paddy ».

7. As cereals and grains had not been included in the data of the years 1957 and 1960, we estimated the weight of straw in the years 1957 and 1960 by utilizing the ratio between the weight of straw and that of cereals and grains produced in the years 1926- 1933.

8. Unlike the statistics of the year 1957, the 1960 statistics made no mention of vegetables and since the assumption that no vegetables existed in the region under study in the year 1960 does not seem to be reasonable, we estimated the vegetables of the year 1960 by using the proportion of vegetables to the total of other crops in the year 1957.

Part III. Weather Factor

According to the publications available from the Meteorology Department this department has no weather station in District 2 of province 6, other than that at Khorramabad, whence we could obtain the required documents and data, and there is only a brief account of the climate of Boroojerd and Golpayegan in the two reports submitted by the Independent Irrigation Institute. We shall therefore consider the climate of Khorramabad, Boroojerd and Golpayegan within the limits of the existing documents.

1. Khorramabad. The data of the meteorological station of Khorramabad utilized in this report includes that dealing with the changes in the amount of precipitation during the cultivation years 1950- 51 to 1960- 61, i. e. 11 years; and those showing temperature changes in the cultivation years 1956 - 57 to 1960 - 61, i. e. 5 years, as given in Tables 4 and 5.

Meanwhile, Chart 1, showing the changes in the amount of annual

precipitation, as well as Chart 2, showing the average changes in monthly precipitation, combined with the absolute maximum and minimum of changes and the monthly average temperature, has been drawn for the Khorramabad station on the basis of the above chart.

The results that can be obtained from the tables and charts are as follows:

A. Regarding precipitation. As shown by the precipitation figures for 1950-51 to 1960-61 for the Khorammabad station, the average annual precipitation of this region amounts to 503 mm., which is suitable for dry farming.

The least annual amount of precipitation, 234 mm., was recorded in the year 1959-60. As shown in Chart 2, the amount of precipitation reaches a minimum in the months of June, July, August and September; and according to Table 4, the amount touches zero in some years. The total precipitation of the autumn, winter and spring seasons is, according to an 11 year average, 159, 224 and 112 mm. respectively. That is to say, the season of maximum rainfall in Khorramabad is the winter, followed by the autumn and then the spring.

Fluctuations in the amount of precipitation in a given month during the 11 years are considerable. These fluctuations are clearly noticeable in the spring and autumn months; the precipitation varying between zero and 26 mm. in the month of October, 0.6 and 207 mm. in November, and 4 and 179 mm. in December.

Likewise it varies between 20 and 192 mm. in April and from about zero to 99 mm. in May. These variations in rainfall in the autumn either retard or hasten the sowing season of cereals, and in the spring determine the effectiveness of the growing season.

These two factors cause sharp fluctuations in the output from year to year.

B. Changes in temperature. As shown by the 5-year data of the Khorramabad station on the changes in temperature (Table 5 and Chart 2), the average monthly temperature of this township never falls below 0° c.

Chart 1

Changes in yearly rainfall in the townships of Khorramabad in millimeters, from the agricultural years 1950/51 to 1960/61. Extracted from the Meteorological Department's publications.

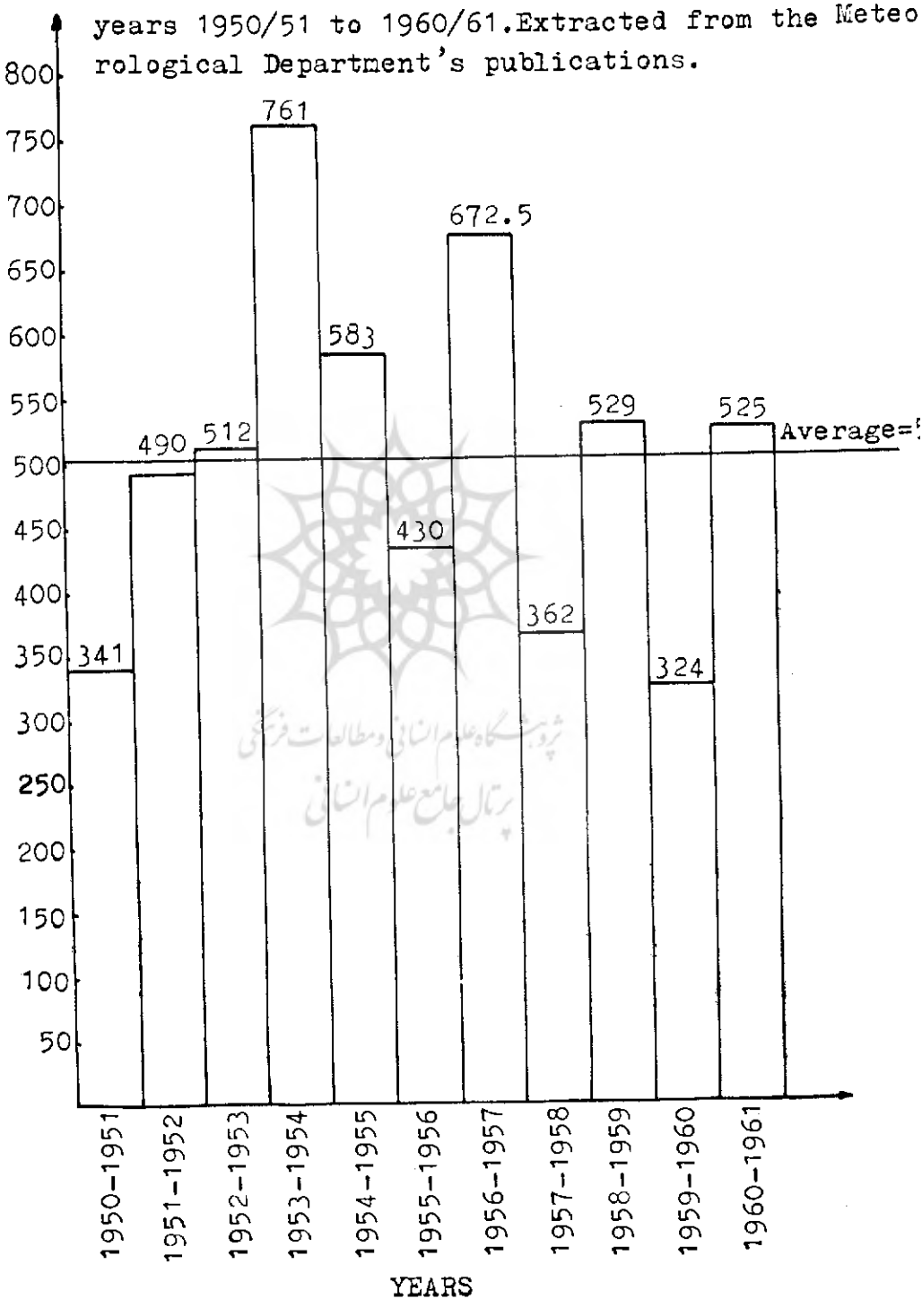
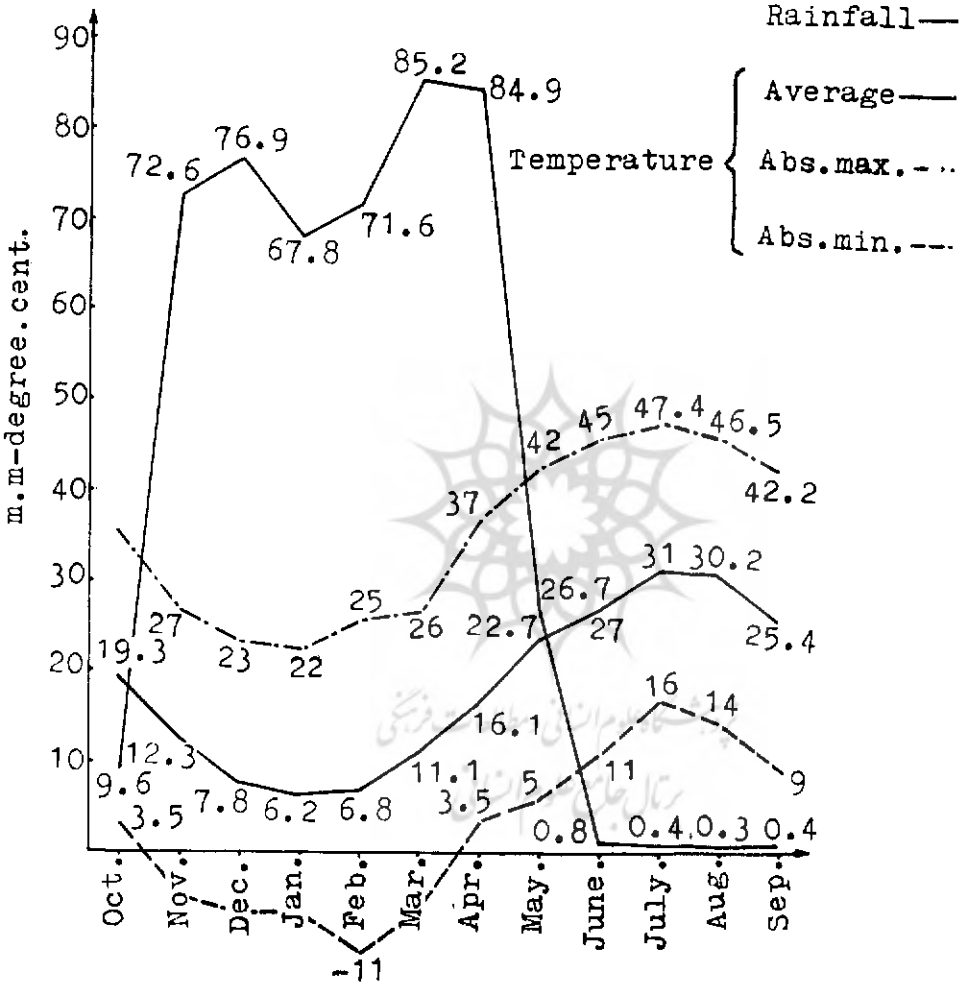


Chart 2

Changes in average rainfall together with absolute minimum and maximum and avevage monthly temperature in the Khorramabad township, extracted from the Meteorological Department's Reports .



The lowest average monthly temperature recorded during the 5 years was 6° c. in the month of January.

The temperature of the five years under study fell below o°c. in the months of November, December, January, February and March, varying between 4°c. and 11° c., and reaching 11° c. in the month of February, 1958 - 1959.

The absolute maximum temperature during the 5 years under study was in the month of July, reaching as much as 47. 4° c. Olnly in 1959- 60 was the absolute maximum in the month of August 2° c above the absolute maximum of the month of July. It may, in general, be said that the coldest month of this township is February and the warmest July.

A cursory glance at Chart 2 will show that the temperature rises abruptly in the spring; in other words, the spring in Khorramabad is short and there is no marked difference between the temperature of the months of June and July. Besides, there is a considerable difference in average temperature between the different months.

C. Combined changes in the amount of precipitation and temperature.

The result obtained from the combined changes in the temperature and amount of precipitation is that in addition to the 3 summer months when rainfall is at its minimum; in fact there is no rainfall in some years; the average monthly rainfall during the month of June is also very low in the period under study. However, in this township the month of June coincides with the wheat harvesting season, and grain cultivation does not need much water. On the other hand, there is sufficient rainfall during the months of April and May, which is the period when wheat grows quickly and there is more demand for water.

About half of the annual precipitation occurs in the winter, and since the average temperature in this season is higher than 6° c., the growth of wheat is not affected except in cases when the temperature falls below zero.

In view of the considerable precipitation during the winter and the possibility of an almost unceasing growth of cereals in this season because the average monthly temperature in the winter never falls below zero, as well as the fact that there is sufficient rainfall in the months of April and May,

it is possible to cultivate grain very efficiently in this township, especially the dry- farmed grain.

This is fully confirmed by the figures given in Table 6, which have been extracted from the 1957 data of the Economics Department of the Ministry of Agriculture.

Table 6.

Population, yield per hectare and percentage of the area under dry-farming cereals of each township of province 6, district 2, as compared with the entire district, extracted from the 1957 data of the Ministry of Agriculture.

Township	Population	Area under dry- farmed wheat and barley (in hectares)	Wheat and barley produced by dry-farming (in tons)	Yield per hectare, (in k.g.)	Cultivated area as a percentage of that of the whole region
Khorramabad	290444	101250	128500	1269	68.94
Aligoodarz	162777	33000	25000	757	22.47
Boroojerd	*91049	12080	11440	947	8.22
Golpayegan	78288	545	430	788	0.37
Whole region	622558	146875	165370	1126	100

* The above figure does not include the population of the city of Boroojerd.

As shown in the above table, despite the fact that the population of the Khorramabad township is less than the total population of the 3 townships of Aligoodarz, Boroojerd and Golpayegau, the greater part of the dry-farmed area of the district under study, (about 69 per cent), is concentrated in Khorramabad. Also, according to this same table, the total yield of dry-farmed cereals in Khorramabad is more than that of the other 3 townships; in other words, because of favourable conditions the yield of dry-farmed cereals in Khorramabad is 1.5 times the average yield of the other three townships.

Although the yield of 1,269 kilos. per hectare in the dry- farmed lands may seem to be an over- estimate, it should be briefly pointed out that, from the viewpoint of sufficient precipitation, favourable temperatures and the resulting high yield per hectare, Khorramabad possesses some of the best dry- farming lands of Iran.

2. **Boroojerd.** According to a report entitled «Irrigation and development project of the plains of Boroojerd, Khorramabad and Tarhan,» submitted by the Independent Irrigation Institute, in 1963, the particulars of the climate of the Boroojerd township can be summarized as follows:

The plain of Boroojerd is considered as a temperate and semi- humid region, the humidity reaching 70 to 75 per cent in the months of December, January and April. The humidity in May, June and July leaves considerable moisture on the land and facilitates the cultivation of dry-farmed crops. The average annual precipitation of about 320 mm. occurs mostly in the spring and winter, and the months of limited rainfall, i.e, less than 10 mm., are the months of June, July, August, September and October. The climate of the plain of Boroojerd is, on the whole, temperate.The average annual temperature is about 13 to 15° c. The difference in temperature between night and day is relatively great. By taking into consideration the amount of precipitation and changes in different seasons, as well as the average annual temperature, it can be said that dry and irrigation farming in this plain can be carried out quite satisfactorily.

The cultivation of crops such as sugar- beet and vegetables is comparatively easy, but that of cotton, owing to the low average temperature in various months, is not so satisfactory.

3. **Golpayegan.** According to a report entitled «Utilization of land and water in the Golpayegan district», prepared by the Independent Irrigation Institute in the year 1955, the temperature of this township varies from 12°c minimum to 36°c maximum. Although these two limits are somewhat less than those of Isfahan, usually crops grown in Isfahan are also found in Golpayegan. And as the growth season, i. e. the interval between the two frosts, (from the second half of April to the end of October), is about 7. 5 months, and during, this period the weather is warm enough for

the sowing and harvesting of tropical summer crops, it is suitable for the cultivation of these crops, especially cotton.

The amount of precipitation in this district is so low that only irrigation farming is feasible. Although there is no weather station in the Golpayegan township, the precipitation in the Akhtekhan Dam district has been calculated as 250 mm., on which basis the precipitation of the Golpayegan plain is estimated at about 200 mm.

From our study of the climatic conditions of the 3 townships of Khorramabad, Boroojerd and Golpayegan, from which regions data has been available, we find that the region under study is divided into 2 distinct districts as regards dry-farming. On the one hand, Khorramabad, with high precipitation, is quite suitable for dry-farming; while Golpayegan, with scanty precipitation, is wholly unsuitable for dry-farming. The climate of Boroojerd, is in between the climates of Khorramabad and Golpayegan.

Part IV. The Soil Factor

In this part we consider various soils in district 2 of province 6, and their suitabilitiy for cultivation. Chart 1, showing the names and the limits of the soils found in the district, has been made by the members of the group with the help of the following two maps:

a. The map of Iranian soils, prepared with the co-operation of the soil experts of the Independent Irrigation Institute as well as the Plan Organization, the United Nations Food and Agricultural Organization; and with the help of two Iranian experts (namely Engineers Famoori and Vakilian).

b. The map of administrative divisions of the country prepared by the General Department of Public Statistics, 1960, from which Engineer Vakilian has classified the soils of the district as follows:

1. **Cultivable Soils**

A. The fine textured alluvial soils (shown by 1). The extent of such soils in the cold region of province 6 is approximately 1,675 sq. kilometers; the soil is the result of deposition of sediments by the rivers and inundation of the plains and the valleys. The characteristics of these soils are very

varied depending on the formations of the regions from which the rivers and inundations have carried these sediments to the plains or valleys.

Generally, the texture of these soils is argillous and heavy and contains lime substances. The natural drainage in most of these soils is unsatisfactory and often deficient.

The surface of these soils is in effect tableland with slight slopes, and in some cases one may detect slight unevenness. On the whole the soil is suitable for irrigation and farming.

A study of the topographic map of the soils in the above- mentioned district shows that some parts of the land should be levelled prior to irrigation.

From the point of view of suitability for irrigation, these soils are regarded as second or third grade. Some of these soils have been irrigated and, at present, are under cultivation with wheat and barley, the remaining lands being either uncultivated, used as pastures, or irrigated at random for casual plantations.

B. Brown Soils (shown by 2). The area of these in the district under study is 1, 488 sq. kilometers. They contain medium and heavy textures having 1 to 2 per cent organic substances in their effective depth. In general, profilic evolution has been detected in these soils so that, in the lower strata, the physical structure of the soils is consolidated and takes either prismatic or block forms. In addition, due to effects of the local atmosphere some quantity of lime substances has been concentrated in this stratum. Lime formation has mostly been hardened into the form of lime concretion. Usually, the texture of these soils is heavy and is called « Clay Loam». As is shown by the map, the surface of these soils is almost flat and only in some parts does the slope exceed 8 per cent.

In general, the area can be utilized for cultivation, but from the standpoint of irrigation, the shallowness of the top- soil creates some limitations.

These lands are in general, good for the dry-farming of wheat and barley. In the case of adopting the irrigation system, attention should be paid to the surfacing and levelling of these lands before growing those plants best suited to the natural conditions.

C. Sierozem Soils (*shown by 6*). The total area is 94 sq. kilometers, and these soils have only been found in the township of Golpayegan. These soils have been formed under semi- dry climatic conditions and their textures vary from light to heavy. Their agricultural value will depend on the availability of sufficient water for irrigation. The proportion of organic substances is very small and its primary elements are variable.

D. Coarse - Textured Alluvial Soils, Alluvial fan, Calluvial Soils and Regosols (*shown by 2a*). The total area of these soils in the area under study is 1,761 sq. kilometers. Their texture is light and contains sand, gravels and rubble stones. The capacity of these soils to hold water is small. Profilic evolution has not been detected, and in general the potential of this land- due to the unevenness of the surface, its comparative steepness and the shallowness of its top soils- is limited.This sort of land is generally fit for planting trees and creating orchards. At present most of these lands have not been irrigated or cultivated and are being used as grazing pastures.

E. Brown Soils Combined with Lithosols (*shown by 7 - 15*). The total area of these soils in district 2 of province 6 is 2,124 sq. kilometers, and can only be seen in the township of Khorramabad. The surface of these soils is unevenly dotted with mounds, and in some places the parent rock, which is frequently of limestone, is conspicuous. Most of these soils are thin, and due to their great unevenness and the steepness of the ground, prove unsuitable for irrigation. On the other hand, owing to sufficient precipita - tion, part of these lands are used for the farming of grains. The remaining part is at present covered with pastures, and if these could be used for dry- farming an immense quantity of grain could be produced.

2. Soils More or Less Suitable for Cultivation

A. Humid Gley and Marshy Soils (*shown by 3*). The total surface area of these soils is 156 sq. kilometers and they are found in the district of Golpayegan.

Due to subterranean water being nearer the surface in this region these soils have gradually tended to become hydromorphic and in their profile, there is to be found a strata known as « Gley » of a grayish- green colour resembling slime. Generally under the present conditions, the possibilities of using them for irrigation and farming are small and before the expansion

of agricultural and irrigational plans these soils should be drained and dried out.

b . Calcareous Lithosols, Brown Soils (shown by 15). The area of these soils extends for 18,659 sq. kilometers. The area is mountainous and consists of limestone and in most cases the parent rocks are visible. The mountainous land, which is only a small proportion of the area, is covered by a layer of soil.

On the whole these are not suitable for irrigation and have no agricultural and little horticultural value.

3. **Uncultivable Lands**

A. Calcareous Lithosol, Deserts and Sierozem Soils (shown as 13). The area of these soils is approximately 2,125 sq. kilometers. It is mountainous. The topsoil is very thin, its moisture- content being also very small. Generally the parent rock can be seen. The suitability of such land for irrigation and cultivation is extremely limited.

B. Calcareous Lithosols Composed of Saliferous and Gypsiferous Marls,(shown by 14) The total area of these soils is 3,555 sq. kilometers and they are to be found in the Khorramabad township. The primary constituents of these soils are saliferous and gypsiferous marls; therefore they contain a certain quantity of salt and gypsum.

The surface is uneven and is frequently covered by hillocks. They are considered to be the basic origin of the so- called salty soils. These soils are usually lacking in vegetation or are thinly covered with plants capable of resisting salt.

They have no agricultural value and cannot be irrigated; only by means of drainage and washing can they be made usable. At present they are arid lands.

C. Lithosols (from igneous rocks) in the Districts of Brown Soils and Sierozem Soils (shown by 16). The area of these soils is 187 sq. kilometers, being found only in the township of Golpayegan. These soils consist of igneous rocks. The land consists of steep hills and hillocks. The topsoil is very shallow,

with parent rocks quite conspicuous. Generally the area is covered with hills and is mountainous and bears no value for farming purposes.

The essential reason for not being farmed is the lack of topsoil.

The area of the various soils in these four townships and their classification into 3 categories : cultivable, more or less proficient for agriculture, and uncultivable; are shown in Table 7.

As seen from this Table, the cultivable area as well as the area more or less capable of cultivation, amounts to 25,957 sq. kilometers, or approximately 81 per cent or 4/5 of the total area of the region. In the 1960 Agricultural Census Report, vol. 8, page 33, Table 104 (2), the total agricultural area including annual and permanent crops, forage, woods and nurseries, and land under fallow, has been given as 481,130 hectares. This means that 18 per cent or less than 1/5 of the cultivable or semi-cultivable land is being utilized for agricultural purposes.

However, if we can find the percentage of the arable and semi-arable land of each township, as compared with the total area, we see that: the township of Boroojerd, with 100 per cent of its land being arable or semi-arable ranks first, followed by Khorramabad and Aligoodarz with 83 per cent of their area, being arable or semi-arable.

The township of Golpayegan, with 39 per cent arable and semi-arable lands ranks third.

As noted, only 18 per cent, or less than 1/5 of the area is under cultivation; it is regrettable to note that in Khorramabad and Boroojerd, land capable of advantageous sowing. with a precipitation from 300 to 500 mm. annually and sufficient humidity for dry-farming is left uncultivated and not used to help in the increase of grain production.

Therefore, with the exception of the township of Golpayegan, which owing to scarcity of rain is not suitable for dry-farming, attention should be paid to dry-farmed grains in this region.

This can be achieved by encouraging the local farmers, or possibly by briniging in cultivators from other parts of the country, helped by government investment, to increase the area under cultivation.

In this way the area under dry-farming would be increased and the

subsequent development of water supplies would add to the area of irrigated land.

The total non-unarable land of this region is 5,867 sq. kilometers,61 per cent of which is in Khorramabad, 22 per cent in Golpayegan and 17 per cent in Aligoodarz. Apparently in the Boroojerd area there are no uncultivable lands.

Part V. The Water Factor

In this part we shall briefly mention the various sources of water for farming in this region. We shall then study the quantity of the water supply and its value in rials per cubic meter for various kinds of farming,and compare this with the other regions already studied.

1. **Sources of Water**

In this region, as in other parts of the country, the water of rivers, qanats, wells and springs is used in farming and the irrigation of crops.

a. *Rivers.* The names of the rivers of this region have already been given in the part dealing with « natural factors», but it was not possible to study them in detail because of the lack of information on the volume of their annual flow and the cultivated area irrigated by each of them. It should, however, be noted that the flow of the Khorramabad river, at Chegini village, was 6 cubic meters per second in 1963, as measured and reported by the engineers of the Land and Water Department. Also, as reported in an English publication, « The Use of Land and Water in the Golpayegan Area», the average annual volume of the flow of the Golpayegan river for the 9 years 1946 to 1955, was 79. 743 million cubic meters. On the other hand, in the month of September 1955, during which the flow of this river was 1400 litres per second, it had watered about 2,320 hectares of the lands of Golpayegan. It may therefore be concluded that in the month of September, each hectare was watered by 0. 6 litres per second.

b. Qanats and Wells. As regards the number of qanats and wells,and their annual quantity of water, and the area watered by qanats and wells in the cold region of Golpayegan, no studies have been made; but according to the said publication, in the year 1955 there were 40 qanats and several wells in Golpayegan.

In the same year, 9,180 hectares of land in that township were irrigated by qanats and 20 hectares by wells.

2. A study of crop yields per cubic meter of water supply and its value in rials, for various types of cultivation in this region, as compared with the regions already studied, as well as the other regions where it has been possible to gather the data required for this study.

This topic has been included under the water factor because, owing to the shortage of water in the country, we have taken the unit volume of the water consumed as a basis for the yield of various types of crops and by using the available data tried to study those selected on the basis of their water consumption and the income earned from the crop produced per unit of water consumed.

For instance, according to the experiments made at the Training Farm of the Karadj Faculty of Agriculture, the water consumption of various crops is as follows :

1,951 liters for 1 kilogram of wheat.

1,384 liters for 1 kilogram of dried hay (alfalfa).

309 liters for 1 kilogram of sugar- beet.

The average water consumption of the other regions under study (excluding the water consumption of the Faculty's training farm) is as follows:

3,968 liters for 1 kilogram of wheat.

7,459 liters for 1 kilogram of unginned cotton.

1,509 liters for 1 kilogram of melons and cucumber.

In view of the above data, and considering the losses arising from the farmers' inattention to the quantity of water required for various crops, (which results in their destruction, etc.), the selection of crops for each region on the basis of their water consumption and the yield obtained from each cubic meter, seems to be of primary significance.

The present study will, therefore, clarify the method of selecting the crops which in any part of the country would, from an economic standpoint, yield the highest income per cubic meter of water- consumption.

The practical result of this study will be an increase in the country's agricultural production and the national revenues from the existing water supply, without having to study ways of increasing the sources of water.

In our study of the cold region of province 6, using the collected data and information, we shall also study the matter in respect of other regions for

which necessary data is available in the following three sections. In conclusion we will show the benefits gained by the farmers from employing the method of determining the production of one cubic meter of water consumed and its value in each type of crops.

Section 1. Water consumption per cubic hectare of various crops during the period from sowing until harvesting.

Section 2. Yield and value of crops per cubic meter of water consumed in various localities.

Section 3. Water- rights and the cost of production and sale of one cubic meter of water from various sources.

Due to the difficulties involved, no comprehensive studies have been made to measure the quantity of water consumed for various crops in different parts of the country, and this method of calculation has not been adopted by the farmers and the makers of water-laws. However, random studies have been made by the Irrigation Department, the Sefid- rood Dam Authority, the Soil and Water Department; as well as the Irrigation Development Group of the Faculty of Agriculture and the Yeganegi Irrigation Company. By utilizing the said reports as well as the data available on precipitation, output of crops and the like, we shall draw up the following tables:

table 8: For Isfahan (watered by the Zayandeh-rood river)
» 9: For Boroojerd (» » Boroojerd »)
» 10: For Golpayegan (» » Golpayegan »)
» 11: For rice cultivation (» » Sefid-rood »)
» 12: For cotton cultivation(» » in Gorgan
» 13: For the training farm of the Karadj Faculty of Agriculture.

In these tables the water consumption per hectare in the sowing-to-harvesting period for various cultivations has been determined in cubic meters by experts by means of various measuring equipment such as partial flume etc. Furthermore, each table shows the yield and the price per kilo of the major and minor crops per hectare for the year 1960, the production and cost of one cubic meter of water having been calculated on the said basis. In our studies we shall utilize the figures of the above tables in the following manner:

1. **The quantity of water consumed per hectare for various cultivations from sowing-to-hrvesting**

The study of Tables 8, 9, 10, 11, 12 and 13 reveals the fact that the quantity of water consumed per hectare for a given crop in various parts of the country differs with humidity, amount of annual precipitation, temperature, permeability of the soil, etc., because:

A. While the water consumption for wheat and barley is, on an average, 7,500 cubic meters in Isfahan, 7,200 c.ms. in Golpayegan and 5450 c.ms. in Karadj, that of Boroojerd is as low as 4,000 c.ms.

Since the annual precipitation in Isfahan, Golpayegan and Karadj is much less than that in Boroojerd, if we add the water consumption of one hectare to the annual precipitation of these four areas, we get the following result:

The slight difference between the total of the above figures may be due to the difference in the permeability of the soils of these regions, and in the temperature and humidity, both of which factors affect the wastage of water.

B. With regard to rice, the water consumption in Isfahan is 52,100 c.ms., while that in Gilan varies from 9,000 in Fooman to 18,000 for the land in the Sefid-rood river-basin, this being due to the low permeability of the Fooman paddy fields and the high permeability of the high soils in the Sefid-rood basin. It is to be noted that the mean annual precipitation in Isfahan is 131 mm., while in Gilan it varies between 1,210 and 1,895 mm. (Rasht: 1,210, Lahijan: 1,334 and Bandar-Pahlavi: 1,895 mm.).

If we follow the aforesaid method of calculation in converting the amount of rainfall into cubic meters of water; we shall obtain 53,400 c.ms. for Isfahan, and a minimum of 21,100 and maximum of 36,950 c.ms. for Gilan. This still leaves a big difference between the water consumption in Gilan and that of Isfahan, the main reason being the dry weather of Isfahan and the high humidity in Gilan, which gives rise to several times more evaporation in the case of the former than in the latter. For this reason, when the temperature rises in the summer in Gilan, humidity approaches saturation point and evaporation drops to a minimum. Since the summer in Isfahan is much warmer but is much less humid than Gilan, the rate of evaporation

in the summer reaches a maximum and results in considerable loss of water.

C. In the case of cotton, the water consumption is 8,900 c.ms. in Isfahan, 7.300 in Golpayegan and 7,560 in Gorgan, which, with the inclusion of rainfall in these 3 districts amounts to 10,200, 9,300 and 1,364 c.ms. respectively. As shown above, the water consumption for cotton cultivation before including the annual rainfall, is almost equal for these three districts, but after the inclusion of rainfall, the Gorgan water consumption exceeds that of the other two districts. This is due to the high yield of cotton in Gorgan.

D. In the case of «Jaliz», (cultivation of melons, cucumber etc.), water consumption is 18,350 c.ms.in Isfahan, 9,310 in Golpayegan and 8,000 in Boroojerd, and by including the annual rainfall, the consumption of these 3 regions amounts to 19,660, 11,310 and 11,500 c.ms. respectively. The difference here arises from diversity of crops and different quantities of water consumption for each.

E. As for vegetables, water consumption per hectare for Isfahan is 25,000 and for Boroojerd 1,200 c.ms. Even with the inclusion of the annual rainfall in Boroojerd, there is a considerable difference between the two quantities. In this case too, as in the case of « Jaliz», the diversity of crops as well as the varying amount of water required by each crop, and the different degree of humidity in the summer, can be considered as the main reasons for the difference in consumption of water for vegetable cultivation in these regions.

F. Water consumption for cereals is 8,500 c.ms. in Isfahan, 8,200 c.ms.in Golpayegan, and 7,000 c.ms. in Boroojerd. In this case, the small difference is due to the diversity in various kinds of cereals.

G. The water consumption for orchards is 9,900 c.ms. in Golpayegan and 8,800 c.ms.in Boroojerd; the difference being negligible.

H. The water consumption of alfalfa cultivation is 17,950 c.ms. in Golpayegan, 12,000 c.ms. in Boroojerd, and 18,000 c.ms. in Karadj. By including the annual precipitation, these 3figures respectively amount to 19,950,15,000-15,500 and 20,400 c.ms. per hectare of alfalfa cultivation.

It should be noted that the water consumption of alfalfa cultivation depends upon the number of maths, and the reason for high water consump-

tion in the Training Farm is the frequency of cuttings and the high yield of the crop.

I. There is little difference in the consumption of water for clover between Isfahan and Golpayegan, the former being 15,675 and the latter 16,800 c.ms.

J. With regard to sugar-beet, the consumption is 9,600 c.ms.in Boroojerd, and that of the Training Farm of Karadj: 17,755 for land fertilized by livestock and 20,065 for those not fertilized.

By converting the annual precipitation of these two regions and adding it to the water consumption per hectare, we get 12,600 to 13,100 c.ms. per hectare for Boroojerd; and for Karadj, 20,155 c.ms. for fertilized land and 22,465 c.ms. for unfertilized land. The question of excess water consumption per hectare of the Training Farm of the Faculty of Agriculture as compared with Golpayegan will be elucidated if we consider the former's ample possibilities and sufficient water supply from the river and deep well, resulting in an average yield of 6 tons of sugar-beet.

K. In the case of red beans, we have the figures for water consumption of one hectare taken from the Training Farm's experimentation with two methods of irrigation. It is interesting to note that the quantity of water consumed by artificial rain is exactly half that of the depressed- bed method of irrigation. The reason for the smaller consumption with rain irrigation is the high efficiency of this method. As regards to the yield per hectare which in the rain irrigation has become 3.5-fold, as compared to the depressed-bed method; if all the conditions of cultivation in the furrows under experiment happen to be equal, as they should, such a big difference is quite astonishing and the experiment must be repeated.

2. **The quantity and value of production per one cubic meter of water consumed for each crop in various parts of the country.**

The calculation of the yield per one cubic meter of water consumed for various crops has certain advantages, the most important being the selection of the most economical plant and the method of its cultivation based on the amount of water consumed. The yield and value of various crops per cubic meter of water based on Tables 8, 9, 10, 11, 12 and 13 are as follows:

A. In the case of wheat, the yield per cubic meter of water in the areas under study varies from a minimum of 200 grs. worth Rls. 106 with its by-products, in Golpayegan, to a maximum of 600 grs., worth Rls. 3.8 including its by-products, in the Karadj experimental farm. The reason for this is, in the first place, the difference between the water consumption and fertility of these regions, and, in the second place (especially in regard to Karadj), the use of improved seed strains, as well as an efficient sowing technique and the enriching of the soil, which have contributed to the increase in production and yield per cubic meter of the water consumed.

B. In the case of barley, the minimum yield per one cubic meter is 200 grs. which with its by-product is worth Rls.1.3 in Golpayegan, and the maximum is 500 grs., worth Rls. 2.9 with its by-product, in Boroojerd.

If we compare the value of the wheat and barley crop obtained from one cubic meter of water in Boroojerd, we will see that although the price of each kilogram of wheat is about twice that of barley, the value of production resulting from one cubic meter of water for barley is more than that for wheat; the reason being than a barley crop can produce a high yield while only using a small amount of water.

C. The minimum yield resulting from one cubic meter of water for unginned cotton is about 52 grs., worth one rial in Golpayegan, and the maximum 198 grs., worth 3 rials, in Gorgan. The reason for this big difference is the low hectare output of unginned cotton in Golpayegan (the yield of cotton in Isfahan, according to the agricultural sample survey of the General Department of Population Statistics in the year 1960, is about 3.5 times the output of Golpayegan,and the yield of unginned cotton in Gorgan is 3.9 times that of Golpayegan).

According to section 1,para. C, the water consumption of cotton cultivation in Gorgan, with the inclusion of rainfall, is more than that of Isfahan and Golpayegan. Still, the value of production per cubic meter of water consumed for this crop in Gorgan exceeds that of the other two regions. The reason is the high hectare output of cotton in Gorgan. This increased output is the result of the fertility of the soil, high water consumption and numerous offshoots in the plant. Thus the consumption of water has decreased as compared to the increase in the yield, and this is the economical production with optimum water consumption, as dealt with elsewhere in this report.

D. The yield per cubic meter of water for the cultivation of opium in Isfahan is 4.5 grs. of juice, with the by-product being worth Rls. 2.5, and that in Golpayegan, 2 grs., at Rls. 1.7, including the by-product in the year 1955. We thus see that the yield per cubic meter of water for opium is more in Isfahan than in Golpayegan. Considering the fact that the yield per hectare and the price of one kilogram of opium juice were almost equal in these two regions during that period, we find that the difference in the water consumption of the two regions (6,000 c.ms. in Golpayegan and 4,000 c.ms. in Isfahan) caused the difference in the value of production per cubic meter of water.

E. The production of paddy rice per cubic meter of water was 48 grs. in Isfahan, worth Rls. 0.523, with its by-product, while that in Foomanat was 246 grs., worth Rls. 2.75, and in the area watered by the Sefid-rood river, 123 grs., worth Rls. 1.3. In view of the fact that the hectare output and its unit price are higher in Isfahan than in Gilan, the big difference in the water consumption of the said three regions decreases the yield, and the rial value of paddy rice obtained from one cubic meter of water in Isfahan, as compared with Gilan, to a negligible level. As stated in the beginning of this report, the reason for the high water consumption in Isfahan, as compared with Gilan, is the dry weather and high temperatures of the summer in the former area and high humidity and low temperatures of the summer in the latter.

F. The difference in the value of production per cubic meter of water in Fooman and the Sefid-rood area is due to the low water consumption of the Fooman rice-fields (about 9,000 c.ms. per hectare) as compared with those of the Sefid-rood basin (about 20,000 c.ms. per hectare). Considering that humidity and rainfall create a difference in the water consumption in the two regions, it can be attributed to the following points:

First, there are vast areas suitable for rice cultivation in Fooman but the available water supply is low, and since the income price per hectare is quite high, the farmers are tempted to increase the area under cultivation, without considering the probability of the withering of crops due to shortage of water. On the other hand, the area under rice cultivation in the Sefid-rood area is limited, although it has a comparatively good water supply. In other words, due to the limited water supply of Foomanat, as compared

with the area under cultivation, less water reaches the unit of cultivation, while this difficulty is less in the Sefid-rood area where the unit area under cultivation gets more water.

Second, the permeability of the Fooman ricefields is less than that of the Sefid-rood area, thus reducing the farmers' water consumption in the former area. Due to these two factors, the water consumption in Fooman is 9,000c.ms. and that in the Sefid-rood 18,000 c.ms. per hectare.

G. The consumption of 52,100 cubic meters of water per hectare in the ricefields of Lanjan of Isfahan is three times that of the Gilan ricefields. The consumption of such an astonishing amount of water in order to obtain 2.5 tons of paddy rice, worth Rls. 27, 271 per hectare, is that it is economical for the farmers, who enjoy a plentiful and gratuitous water supply, (the cost of production or the sale of one cubic meter of water has been dealt with in part 3 of this report) and own a limited plot of land. Probably no other crop would yield the same income under the existing conditions.

However, we should always be intent on increasing the national wealth and income in all sectors, especially in agriculture. Considering the vast lands of other villages lying in the lower parts of the Zayandeh-rood river which have remained uncultivated for want of water-rights, the figures of water consumption in the previous tables show that if the same 52,000 c.ms. of water were to be used to cultivate 5 to 6 hectares of cotton, 6 hectares of potatoes or 3 hectares of melons, cucumbers etc., instead of one hectare of rice, the crops obtained would be worth Rls. 119,595 in the case of cotton,Rls. 322,806 for potatoes, and Rls. 200,000 for melons, cucumbers etc. This would provide a greater source of income for Iranian society. The old laws and regulations on the distribution of the water of the Zayandeh-rood, like the Scroll of Sheikh Bahaie, has given the farmers of Lanjan the right of using large quantities of water for small areas under rice cultivation. This was probably due to the growing need of Isfahan for rice, and the difficulty of importing this commodity for long distances from the north of Iran by the existing slow means of transportation. Thus, with a view to encouraging the farmers to cultivate rice in the region of Lanjan, the government was compelled to increase their water-rights under special laws, especially as there was a limited cultivation of industrial crops as well as melons, cucumbers etc., these products not being exported from Isfahan but used only for local

consumption. However, the method suggested for calculating the yield of crops resulting from a cubic meter of water shows that time has changed the situation, and that present requirements necessitate a reconsideration of the old laws governing the consumption of water.

H. The production per cubic meter of water for sugar-beet is 0.674 kilos at Rls. 0.8 in Boroojerd; and the average for the Karadj lands, whether fertilized or not, is 3.248 kilos at Rls. 3.9. This shows that although the water consumption per hectare of sugar-beet in Boroojerd is about half that of Karadj, the latter's income resulting from one cubic meter of water is 4.8 times that of Boroojerd. The reason for this can be sought in the proper cultivation techniques in Karadj and the resulting high hectare-yield. Consequently, modification in the technique of cultivation and the enriching of the soil causes a decrease in the water consumed per unit of production, or a greater yield using the present water supply.

I. It also seems useful to study the production per cubic meter of water for crops within each group of the summer and winter crops, fodder and rice, as a whole, and to make an economic comparison between the said groups. To clarify the matter, we shall divide the crops of each region into four groups, namely: summer and winter crops, rice, and fodder for livestock.

We shall then calculate, within each group, the average production per cubic meter of water for various crops in different localities, extracted from tables 8, 9, 10, 11, 12 and 13, and demonstrate the result in the following table:

The results obtained from this table are as follows:

First, in all the regions under study, the amount and value of production per cubic meter of water in the summer cultivation areas are, despite the large consumption of water, generally more than those areas of winter cultivation which need a smaller amount of water. The reason is the greater yield per hectare and the higher price of summer crops.

Second, the yield and value per cubic meter of water in the cultivation of fodder crops like alfalfa and clover, are quite low due to their very large water consumption. The production and value per cubic meter of water for the cultivation of alfalfa on the Training Farm at Karadj are

notably lower than those of the other localities under study. But if we compare this crop with the other products of Karadj shown in table 6, we will see that the value of production per cubic meter of water for alfalfa is much less than that of other crops. However, since the cultivation of these plants will enrich the soil, causing an increase in the yield of subsequent crops, the alfalfa and clover have in fact contributed to this increased yield and income.

Furthermore, as fodder plants are used in livestock raising, which is the main basis of agriculture, the cultivation of these plants is always desirable.

Third, the production and value per cubic meter of water of the summer crops of Isfahan are generally more than those of the other two regions under study; namely Boroojerd and Golpayegan. The reason is the intense activity, the efficient cultivation techniques, and the selectivity of the Isfahani farmers in raising their crops.

The general conclusion to be drawn from this section is:

The quantity of water consumed for obtaining an economical product, or obtaining the maximum value of production per cubic meter of water consumed in the cultivation of various crops, depends on: the natural fertility of the soil, the mode of enriching the land, the type and quantity of fertilizer used, the type and species of the plant, the technique of cultivation, the prevalence of plant pests, and the price of the crops produced. As a result of the above factors, the more fertile the soil and the more favorable the atmosphere for the plant, the greater will be its income per cubic meter of water consumed.

3. **Water- rights and cost of production and sale of one cubic meter of water from various sources**

The various sources used for irrigating cultivated lands in Iran include rivers, qanats and wells.

1. *Rivers.* The existing laws, regulations and customs which have been in force since ancient times, have established rivers as the cheapest source of irrigation, and river water has been distributed freely among the farmers by means of so-called « water-rights ».

However, along the course of river-feeding installations like tunnels. and dams for storing, regulating or increasing the water supply, those using the

water are charged a certain sum annually, (depending on the cost of depreciation and maintenance of the installations). This sum is proportional to the area under cultivation.

The rivers mentioned in this report are those of the Zayandeh- rood, Boroojerd, Golpayegan, Sefid-rood and Karadj.

A. As regards the sale of the *Zayandeh-rood water*, it should be noted that prior to the creation of the Koohrang tunnel, this water was distributed gratious among the farmers who enjoyed water-rights according to the Sheikh- Bahaie scroll. But they should now pay a total of about rials 8,500,000 for using additional water produced by the construction of the said tunnel. In fact, part of the water consumed by the holders of water-rights is free of charge as before, and what they pay for is the additional water made available by the construction of this tunnel. In general, from the present data to hand we cannot determine the cost price of one cubic meter of water or the payment for the water-rights in this region.

B. Also, with regard to the sale of the water of *the Boroojerd river*, no data has so far been obtained. Since no dam or tunnel has been constructed over this river, as in the case of the Zayandeh-rood; it is presumed that the farmers pay nothing for using its water. However, according to the report on the project for Irrigation and Development of the plains of Boroojerd, Khorramabad and Farahan, the cost of obtaining one cubic meter of water by pumping (at points on the river where the river-bed necessitates this process), amounts to Rls. 0.36.

C. *The Golpayegan Dam Authority* collects annually Rls. 500 per hectare from the farmers enjoying water-rights, and Rls. 1,500 from those without water-rights.

By utilizing the above figures, a table has been drawn up to show the sale price and the income in rials of each cubic meter of water, after the deduction of the price of water for the crops of the Golpayegan region.

D. *The Sefid-rood Dam Authority*, charges the farmers with water-rights Rls. 720, and those without, Rls. 1,500 per annum (for each hectare of rice cultivation). By using the above data, table 15 has been drawn up for the Gilan region, (as Fumanat is not irrigated by the Sefid-rood water, and the sale price of water in this region is not known, we have shown only the income from each cubic meter of water in this table).

E. The Karadj river. According to the Karadj River Department, in the year 1960 the villages enjoying water-rights paid a negligible amount of about Rls. 300,000 in cash and kind (kind being wheat and barley).

However, as the water consumption of those enjoying water-rights is not known, we cannot calculate the price per cubic meter of water.

After the establishment of the Karadj dam, the total quantity of water distributed among the holders of water-rights amounted to 160,000,000 c.ms., against payment of the sum of Rls. 300,000 as mentioned above;i.e. only Rls. 0. 0018 per cubic meter. But the sale-price of water to those having no water-rights in Karadj is Rls. 0.2 per c.m.

The buyers of the Karadj river water are the Tehran Water Board,the government institutions of Karadj, including the Agricultural Faculty,as well as private institutions.

According to the agreement concluded between the Agricultural Faculty and the Irrigation Department of Karadj, the Faculty pays Rls. 0.2 per c.m. to the said department. The quantity of water consumed is determined in «*sangs*», each « sang» being 12 liters per second.

We have drawn up Table 16 for the Training Farm of the Agricultural Faculty to show the income from one cubic meter, less the sale-price.

The Training Farm is irrigated by deep-wells, the short-fall being met by the Karadj river.

2. *Qanats.* No data is availabale on production costs and sales of qanat water. In regard to Golpayegan, reference is made to the water magazine which shows the sale-price of a cubic meter of qanat water in the said township at Rls. 0.17 to 0.20. However, as the qanats of this region have gone dry during recent years, the sale of qanat water has been omitted.

3. *Wells.* Studies have also been made to determine the cost price of 1 c.m. of deep well water, based on the the figures calculated for the Training Farm of the Agricultural Faculty of Karadj by the irrigation and development team of the Faculty, as well as of the deep wells of Gorgan (Peyvand Co.); the calculations being made by the agronomic team of the Faculty, and the data obtained from the Yegangi Irrigation Co. In general, the cost price of each cubic meter of deep-well water fluctuated between 0.7 and 1 rial depending on the depth of the well, type of pump and motor, manner of depreciation, hours of work, flow of the well and so on.

As an example, we have calculated and shown in the following table the cost of production of 1 c.m. of the water from the well of the Training Farm(of the Karadj Agricultural Faculty) and that of the Peyvand Co. in Gorgan.

As shown in Table 18, the rial income from each c.m. of water for various crops, both before and after deduction of the cost price of water is comparatively high (about Rls. 0.9). The reason for such a high income is revealed by the fact that the crops cultivated at the Training Farm are of an experimental nature and that considerable expenses have been incurred on their irrigation, fertilization, pest control and other operations. With regard to Table 19, although the cost price of each c.m. of water is Rls. 0.83, the income from each cubic meter, less the price of water, was satisfactory, and the cultivation of cotton using deep-well water was economical in this region.

The figures given in the above table show the average price of 1,c.m. of water in the localities mentioned, and do not include the other regions under study. They can however, serve as a basis for comparison. Hence we will compare the above table with Tables 8, 9, 10, 11, 12 and 13 of the section, with the following results.

a. In *Isfahan* the income per c.m. from the cultivation of paddy rice is Rls. 0.523, of clover, Rls. 0.273, and of gargarau, Rls. 0.531. Obviously, the irrigation of these crops with water from wells, at Rls. 0.862 per cubic meter, is not economical.

Even if the other production expenses were disregarded, the cost price of 1 c.m. of water would exceed the rial income and would certainly incur a loss. Naturally, the irrigation of the said crops with qanat water, though involving no losses, would yield less income as compared with irrigation by river water.

b. In *Boroojerd* the income from 1 c.m. of water in the cultivation of sugar-beet is Rls. 0.808, and of alfalfa, Rls. 0.457. In this case too, cultivation with water from wells entails a loss, with the difference that the loss sustained from sugar-beet cultivation is less than that of alfalfa. However, the cultivation of sugar-beet using well water at the Karadj experimental farm proves to be economical.

But as this difference in the production value per c.m. of water for sugar-beet in these two regions arises from a more efficient cultivation technique and the proper fertilization of the soil in the Karadj Training Farm, it may be said that cultivation with high cost will prove economical only if the production value or the rial income per c.m. of water is made to exceed its cost price by improving cultivation techiques and enriching the soil with fertilizer.

C. In the *Golpayegan* region, the income per c.m. of water for alfalfa cultivation is Rls. 0.305, and that of clover Rls. 0.187. It is evident, for the same reasons, that so long as the rial income does not exceed the cost price in this region, the cultivation of these two plants using well water at a price of Rls.0.85 per c.m. will cause a loss.

In considering the price of qanat water, we find that the rial income per 7 c.ms. of water in clover cultivation is less than the cost price; hence irrigation in this case with qanat water is not advisable.

In the cultivation of alfalfa, although irrigation with qanat water involves no loss, it yields a smaller income when compared with river water.

In the regions under study the cultivation of the other crops mentioned in the above tables would probably be economical, irrespective of the water source.

In general, out of all the expenses necessary for the raising of crops, this report deals exclusively with the cost price or the purchase price of 1 c.m. of water, leaving out other production expenses (such as those of ploughing, fertilizer, seeds and so on). Therefore, the rial income from each cubic meter of water should exceed the cost price in the case of wells and qanats; or the purchase price in the case of rivers. In other words, the more the rial income per c.m. of water exceeds the cost price or purchase price, the greater the likelihood of the farmer's profit.

Conclusions drawn from this study

According to the above, the proceduressuggested possesses the following advantages.

A. The possibility of computing the optimum water consumption needed to obtain a maximum yield, with due regard to the question of the disproportionate output of each crop, so that the most economical one may be selected.

B. The possibility of determining the quantity of the required fertilizer as well as the agro-technical method for each crop, in order to get a maximum yield from the water consumed.

C. Determination of the relationship between the natural fertility of the soil and the type of plant cultivated, with a view to determining the optimum water consumption necessary for obtaining a maximum output.

D. Finally, the main result of following this procedure would be to draw the attention of those concerned to the necessity of reconsidering in general the laws of water consumption which have been in force in the country since ancient times. This will lead to an increase in the country's agricultural production and the national income, and full utilization of our water resources, thus avoiding an excessive consumption of water as occurs in rice cultivation in Lajnan of Isfahan.

Table 14

Sales price and rial income per cubic meter of water from the Golpayegan river after deduction of the sale price of water.

Name of crop	Income per cu.m. of water in rials	Sale price per cu.m. of water in rials		Income per cu.m., less price of water	
		with water rights	without water rights	with water rights	without water rights
Wheat	1.630	0.050	0.150	1.580	1.480
Barley	1.316	0.050	0.150	2.266	1.166
Cotton	1	0.050	0.150	0.950	0.850
Alfalfa	0.305	0.050	0.150	0.255	0.155
Clover	0.187	0.050	0.150	0.137	0.037
Melon and cucumber	2.208	0.050	0.150	0.158	2.058
Opium	1.677	0.050	0.150	0.627	1.527
Cereals(peas)	0.941	0.050	0.150	0.891	0.791

Explanation: For calculating the price of one cubic meter of river water, first the average consumption per hectare was computed for farmers with water rights paying Rls.500 and those without water rights paying Rls. 1,500 per hectare of their cultivation; that is to say, water consumption for various crops was added and then divided by the number of crops raised and the figure 9, 995 was obtained as the average consumption of water per hectare. Thus the price per cubic meter of water is 500: 9, 995 = Rls. 0.05 (with rights) the price per cubic meter of water is 1500:9,995 = Rls. 0.150 (without rights).

Table 15

Sales and rial income per cubic meter of the Sefid-rood water after deduction of sale price of water.

Name of crop and district	Cost of production per cu.m. of water in rials	Sale price per cubic meter of water in rials		Income per cubic meter of water after deducting cost of water in rials	
		with water rights	without water rights	with water rights	without water rights
Rice (Sefidrood)	1.370	0.040	0.083	1.330	1.287
Rice (Fumanat)	2.750	-	-	-	-

Table 16

Cost price and rial income per cubic meter of water for various plantations of the Training Farm of the Karadj Agricultual Faculty, after deducting cost of water (irrigated by river).

Name of crop	Value of production per cu. m. of water used (rials)	Price per cu. m. of river water supplied by Karadj Dam Organization (rials)	Income per cu. m. after deducting cost. (rials)
Sugar-beet fertilized by animal manure	4.224	0.2	4.024
Sugar-beet without fertilizer	3.573	0.2	3.373
Red-beans by depressed irrigation	2.349	0.2	2.149
Red-beans by artificial rain	16.547	0.2	16.347
Wheat, Atayee	4.325	0.2	4.125
Wheat, Gazorsang	3.869	0.2	3.669
Wheat, Shahpasand	3.777	0.2	3.577
Wheat, Spring	3.130	0.2	2.930
Alfalfa	2.888	0.2	2.688

Table 17

Water supply cost per cubic meter from wells of the Training Farm of the Karadj Agricultural Faculty and the Peyvand Co. of Gorgan.

Cost of Production of 1 cu.meter of water (in rials)	Well of Training Farm of Karadj Agricultural Faculty with a flow of 158.45 cu. m. per hour.	Two wells of Peyvand Company with a flow of 756 cu. m. per hour.
Depreciation and abatement charges	0.458	0.572
Cost of fuel, lubricant, filter, battery, labour, etc.	0.437	0.258
Total	0.895	0.830

Now with the help of Tables 12, 13 and 17, we draw up Tables 18 and 19.

In these two tables income per cu.m. of water has been computed after deduction of the cost.

Table 18

Cost price and income in rials per cubic meter of well water of the Training Farm of the Karadj Agricultural Faculty, after deduction of the cost price of water for various crops.

Name of crop	Income per cu.m. of water (rials)	Cost price per cu.m.of water (rials)	Income per cu. m. of water after deducting cost. (rials)
Sugar-beet, fertilized by animal manure	4.224	0.895	3.329
Sugar-beet without animal manure	3.573	0.895	2.678
Red beans by depressed irrigation	2.349	0.895	1.454
Red beans by artificial rain*	16.547	0.895	15.452
Wheat, Atayee	4.325	0.895	3.430
Wheat Gazorsang	3.869	0.895	2.974
Wheat Shahpasand	3.777	0.895	2.882
Wheat Spring	3.130	0.895	2.235
Alfalfa	2.888	0.895	1.993

* The unusually high income for this item may be due to wrong experimentation resulting in excessive yield. In order to verify the figure the experiment should be repeated.

Table 19

Cost price and rial income per cubic meter of well water of the Peyvand Company, Gorgan, after the deduction of cost price of water in cotton plantations.

Crop	Income per cu.m. of water (rials)	Cost price per cu.m. of water (rials)	Income per cu.m. of water after deduction cost (rials)
Cotton	2.976	0.830	2.146

Table 20 has been drawn up for comparing the cost price of the deep well water with the price of each cubic meter of the water of qanats and rivers.

Table 20

Average cost price and sale price of one cubic meter of water from various sources.

Source of data	Water Source	Average price or sale price per cubic meter in rials
Sefid-Rood Dam Authority Golpayegan Dam Authority Karadj river's Department	River	0.045 to 0.144
Water Magazine no.1, March, 1961 page 49, Rate of Sale in Gougad Village	Qanats	0.214
Peyvand Company of Gorgan, Training Farm of Karadj Agricultural Faculty	Well	0.862

Remarks: The average sale price per cubic meter of water (without taking into consideration the Karadj river, the price of which is insignificant) is Rls. 0.045 for those with water rights, and 0.144 for those without water rights.

Part VI. Division of crops between landowner and farmer

This section explains the nature of the landlord farmer relationship from the standpoint of the division of crops in district 2 of province 6, before the enforcement of the Land Reform Law. The data for this section has been extracted from the 1957 questionnaires of the Economic Department of the Ministry of Agriculture.

As stated in our previous reports, from the standpoint of division of crops, there are two kinds of systems in the country in general, and in district 2 of province 6 in particular, namely: (1) Lease or tenancy system, and (2) Crop sharing system.

1. *Tenancy.* With regard to the renting of the cultivated land of the region under study, the only data that can be extracted from the questionnaires of the Economic Department of the Ministry of Agriculture are those related to the zone of Khansar in the Golpayegan township; in which a 10 to 20 year tenancy has been given, without any indication of the amount of rent or whether it is paid in cash or kind. It follows that the division of crops between landowner and farmer is of the tenancy system type only in Golpayegan, while the crop sharing method is utilized in other parts of district 2 of province 6.

2. *Crop sharing.* This method consists of a division of the crop between the owner and farmer on the basis of production factors, namely: water, land, oxen, labor and seeds. Besides these 5 factors, which have always been the basis for the division of crops between owner and farmer; a certain quantity of fertilizer, more in summer crops and less in winter crops, is also used in this district (usually at the farmer's expense), and may therefore be considered as coming under the labor factor.

In the district under study, the production factors have, in general, been divided between the owner and farmer in the ratio of 2:3; that is to say, in almost all the districts, land and water are undertaken by the owner, and oxen, labor and seeds by the farmer; except in the dry-farming of cereals when the owner provides only the land whereas the farmer supplies the oxen, labor and seeds.

There are of course exceptional cases, as in the zone of Khonsar in the Golpayegan township, when the owner provides the land, water, and oxen, and

occasionally the fertilizer in summer and winter cultivation, while the farmer bears only the labor factor. In this case, the owner has a three- quarter share of the crop, and the farmer one quarter; and since the farmer's share is based solely on the labor factor, he is called *Barzegar* (Agricultural laborer). A fixed share of the crop is his wage in kind, this share being one fifth in some districts and one quarter in others.

Agricultural laborers, therefore, work for the owner or for the farmer. For instance, when the division of crops between the owner and the farmer is made on the basis of two-fifths to three-fifths, the farmer may provide the oxen and seeds, and the agricultural laborer furnishes only his labor, in which case the latter receives one out of the three shares of the farmer.

To examine the manner of the division of crops in the region under study and to obtain a general and comprehensive ratio for each crop, we studied the crop division ratios in the various zones of district 2 in province 6.

For every kind of crop in this survey, we followed the most common method of division. After having found the most usual method of division of crops in every area as well as in every township; we disregarded the exceptions, and obtained a general method of division for various crops for the entire region.

Table 21, which has been drawn up on the basis of the data gathered by the Economic Department of the Ministry of Agriculture, shows the manner of the division of crops, in various types of cultivation, in region 2 of province 6.

From Table 21 it appears that when in the cultivation of irrigated wheat and barley, the land and water are provided by the owner, and the oxen, seeds, labor and fertilizer by the farmer; the farmer's share varies between one third and one half, and the latter's between one half and. two thirds. In the case of dry-farmed wheat and barley, when the land is provided by the owner, and the oxen, seeds and labor by the farmer, the farmer's share is one fifth or one quarter, two fifths, or at a maximum, and the latter's three fifths or three quarters, or at a maximum four fifths.

In the cultivation of rice, cotton, beet and tobacco, and in summer crops generally, when the land and water are owned by the landlord, and the oxen, seeds, labor and fertilizer supplied by the farmer; the owner's share differs from one third to one half, and the farmer's from one half to two thirds.

We thus find that the ratio of division of crops between owner and farmer in the region under study does not greatly fluctuate from one township to another. These ratios were somewhat similar in various regions, the unusual cases being exceptional.

If we examine the amount of precipitation and the types of water sources in the townships of this region, we will see that the average annual precipitation is about 200 mm's. in Golpayegan; 300-350 mm's. in Boroojerd; and more than 500 mm's. in Khorramabad: as such, the amount of precipitation in Boroojerd, and even more so in Khorramabad is comparatively satisfactory. Golpayegan, however, has little rainfall and is considered a dry region.

Furthermore, the greater part of the water required for cultivation is surface water; and the number of wells and qanats in this region is negligible. Therefore, the problem of water shortage which could be an important factor in the division of crops, is not as acute in region 2 of province 6 as it is in the dry regions like the province of Isfahan, (especially in Yazd, Nain and Ardestan); that is to say there is comparatively adequate precipitation, and the price of water from springs and rivers is quite low. On the other hand, owing to the rich underground water supplies in most of the districts of the region under study, even the water from qanats and wells is obtained at a lower cost than in regions like Yazd, Nain and Ardestan.

It should be noted that in the economic report on the crops of the province given in issues 9 and 10 of the Quarterly Journal of Economic Research «Tahqiqate Eqtesadi», the diversity of methods of dividing the crops, especially in Yazd, Nain and Ardestan, was attributed to inadequate precipitation and to the limited number of rivers, as well as to the wide use of well, and especially qanat water.

Due to the great length of the qanats and the heavy expense involved in their digging, it has been shown that the water factor is of foremost significance and has tipped the balance in favor of the owner or the holder. By taking these points into consideration it can be concluded that the reason for the small variations in crop sharing ratios in the region under study is the comparatively low cost of water. We can thus say that crop sharing in this region follows the norm based on the parity of the production factors.

With regard to Table 21, we can sum up the crop sharing procedure

in district 2 of province 6 as follows:

1. In the case of irrigated wheat, barley, rice and summer crops,(cotton, sugar-beet, tobacco); when the land and water are provided by the owner, and the oxen, seeds, labor and fertilizer by the farmer; one third of the crop belongs to the owner and two thirds to the farmer.

2. In the case of dry-farmed wheat and barley, when the land is furnished by the owner, and the oxen, seeds and labor are provided by the farmer, one quarter of the crop goes to the owner and three-quarters to the farmer.

Part VII. Energy and Labour Factors

Labour and energy are two of the five essential factors of production. In most parts of the country labour is provided by farmers and power by oxen. However in some areas, including most of the villages of Isfahan, ploughing is done by spade and energy is supplied by the farmer's manual labour. Thus, in the report on the hot regions in issues nos. 3 and 4 of the Quarterly Journal of Economic Research, horses and mules are mentioned as being used for big tillage, and oxen and donkeys for small tillage.These terms are used in townships like Dezful and Shushtar, where horses and mules are usually used for ploughing. A big tillage area gives more crops as compared to a small tillage area, and on the average the cultivated area in big tillage is approximately four times that of small tillage.

In district 2 of province 6, which is similar to the hot region of Khuzistan, mules and donkeys are used in addition to oxen as ploughing factors.

According to the 1926 to 1933 data, apart from oxen, only donkeys had been in use for tillage in Golpayegan and in some parts of Aligoodarz

However, the total number of oxen in this district is 43,529 and the total number of donkeys 1,582. The area tilled by donkeys is 3.5 percent of the total tilled area.

The General Department of Public Statistics in it's publication has given horses and mules as energy factors in addition to oxen and donkeys. In the same year the number of donkeys was 300, horses and mules 1,200, and oxen 113,406.

It has been noted that the ratio of tillage by donkey as compared to the total tillage area is 0.26 per cent, and the ratio of tillage by horse and

mule as compared to the total tilled area is 1.04 per cent. In this district in general, the ratio of tillage by mule, horse and donkey as compared to the total is 1.3 per cent; therefore, due to the insignificant amount of tillage carried out by donkey, horse and mule as compared to the total ploughed area, we can avoid the classification of big and small tillage and accordingly take at par the various mediums of tillage. Undoubtedly there may occur some errors in calculation which can be overlooked.

With due consideration to the above mentioned, we shall now study the following points:

1. Changes in cultivation area, its production and its value per ox in district 2 of province 6, of the annual farming crops during the last 35 years, and comparison of the same with the localities already studied. For this purpose, we shall use the data of sample villages extracted from the Auditing Documents of the years 1926- 1933, and similarly the 1957 and 1960 statistics as mentioned in Table 3 of this report, and we will proceed to draw up Table 22.

The conclusions obtained from this table are as follows:

a. The area cultivated by an ox of wheat and barley within the years 1926-1933 is equal to 2.4192 hectares, and the average for the years 1957 and 1960 is equal to 1.9566 hectares: it will be noted that the cultivated area of grain per ox within this 35 year period decreased by half a hectare.

b. The cultivation area by an ox of all crops during the recent years is 2.1523 hectares; the remaining area of wheat and barley was used for other crops, (2.1523-1.9566 equals 0.1958 hectares).

Henceforth, the grain cultivation area accounts for 91 per cent of the total number of oxen used for the plough. In other words 91 per cent of the ploughing by ox is for grain and the remaining 9 per cent is assigned to the other crops.

This ratio holds true throughout the entire district: possibly, the discussion of this subject would have been more appropriate in the section related to the combination of the factors involved.

Therefore, in comparing the situation of district 2 of province 6 with other areas so far studied, we have: in Isfahan, 77 per cent grain and 23 per cent other crops; Gilan, 88 percent grain and 12 per cent other crops;

Khuzistan, 94 per cent grain and 6 per cent other crops. Thus from the standpoint of the importance of grain cultivation, the farmers of Khuzistan and Zanjan with 94 per cent of the total cultivated area per ox allocated to wheat, barley and rice, rank first. District 2 of province 6 with 91 per cent ranks second, Gilan with 88 per cent ranks third, and last of all Isfahan with 77 per cent ranks fourth.

c. The average value of production per ox of all crops between the years 1926 to 1933 is almost Rls. 30,872, while during 1957 and 1960 the average was only Rls. 16,532, (or approximately a decrease by half the amount). As the production value per ox among all the crops determines the living standard of the farmers and is important from this point of view, its decline in district 2 of province 6, in the recent years as compraed with 35 years ago accounts for the gradual impoverishment of the farmers in that district. Thus an analysis and discussion of this topic seems to be essential.

The decrease of the income from production per ox in this region is due to the following causes:

First, as the production of grain per ox over the 35 years has not altered, the static price of wheat and barley is one of the reasons for the decrease in the value of production per ox.

Second, the income resulting from cultivation of opium which was Rls. 3,000 per ox 35 years ago has now been totally eliminated.

Although the cultivation of opium has been replaced by that of wheat and barley in the whole district, (refer to part 8 of this report), it has not compensated for the fall in the income per ox, because the increase in production of wheat and barley in the whole region is not the result of an increase in the cultivated area and production per ox; (refer to Table 22 figures which show a decrease), rather it is due to the increase in the number of oxen (Table 24).

Third, some cultivations such as fodder plants, other wet farming grain, tobacco and cotton, show a decrease over the last 35 years; this results in turn in a decrease in the income of the district from other crops, and accordingly in the value of production per ox.

d. In order to compare the production per ox of district 2, province 6, from the point of view of the parameters mentioned above, with those of

the districts so far studied, Table 23 has been formulated.

Table 23 shows that, with the exception of the Gilan district where the production value per ox as compared to the prices between 1926- 33 has increased by about 75 per cent and each farmer has an extra income from his ox labour; in Zanjan, district 2, province 6, Khuzistan and Isfahan the production value per ox has continually fallen since 1926-1933, and up to 1960, resulting in the fall of the farmers' income.

It is evident that this income does not include all the earnings of the farmers, such as those from cattle breeding and fruit growing. But as their major income is from production per ox of the annual crops, the decrease in the income has an undesirable effect on the living standards of the farmers.

2. A study of the relationship between the population changes and the cultivation area of grain with those of changes in the numbers of oxen and cultivation of grain during the recent 35 years in district 2, province 6; as well as other areas so far studied.

For this study, we shall use the information acquired so far in various regions, from which we shall formulate Table 24. The results thus obtained are summarized as follows:

Percentage of increase or decrease of various parameters during the 35 year period.

District	Population	Total cultivated area of grain	Number of oxen	Cultivated area of grain per ox
Zanjan	-67	+60	+52	+5
4 townships of Khuzistan	+84	+52	-18	+28
Gilan	+117	+105	+22	+68
District 2 of province 6	+108	-103	+155	+20

Considering that the increase in the cultivated area which in itself is the result of population growth, can be accomplished by either increase of oxen or increase of cultivated area per ox, or else by both, we conclude as follows:

First, the twofold increase in the grain area in district 2 of province 6, and the 1.5 times gain in Zanjan is mainly due to the increase in the number of oxen (2.5 times in district 2 of province 6 and 1.5 times in Zanjan), while the increase in cultivated area per ox not only does not have any positive effect but has even decreased by 20 per cent and has had a negative effect.

Therefore in this district especially, the income accrued from increasing the cultivated area of grain of the owners of water and land on the one hand, and on the other of the rural inhabitants as a whole, has had no effect on the standard of living of the individual farmer; because according to what was mentioned in paragraphs (c) and (d) of this section, the production value per ox in district 2, province 6, and in Zanjan within the 35 year period has decreased by half that of 1926- 33.

Secondly, on the other hand, the doubling of the cultivated area of grain in Gilan within these 35 years is chiefly due to the increase in cultivation area per ox (about 68 per cent), rather than the increase in the number of oxen, as this was only 22 per cent. Thus the increase of production and its value in Gilan has been more to the credit of the farmers.

Third, the 18 per cent increase in the number of oxen and the cultivated area have both affected the cultivated areas in the four townships of Khuzistan (Dezful, Shushtar, Behbahan of Kohkiluyeh and Ramhormoz).

Part VIII. Consequences of the Abrogation of Opium cultivation

To study the agricultural and economic results of opinm cultivation abrogation in district 2 of province 6, we drew up table 25 by utilizing the data of the years 1926 to 1933, the 1935 Agricultural Statistics Book of Iran and the statistics of the ex-Opium Monopoly Department 1943- 1955.

Table 25

Cultivated area, output and price of opium during selected years

Cultivation year	Cultivated area in hectares	Opium-juice in kilos	Price per kilo in Rls.	Total value of opium in Rls.
1926-1933	4,153	73,059	56.99	+4,163,884
1935	3,325	56,080	—	—
Annual average for 1943-1955	1,882	24,624	515.90	12,705,843

From the table we note that the last years of opium cultivation in Iran, i.e. 1943-1955, show a definite drop in average cultivated area and yield as compared to the years 1926-35, when the area under opium cultivation was approximately 1.5 to twice as large and the production 2 to 3 times more than the average area and production in the years 1943-55.

The reason for this decrease, as mentioned in issues nos. 9 and 10 of the « Tahqiqate Eqtesadi», may be the curtailment of the export of opium as a result of the loss of foreign markets such as Japan and China, or more probably, by keeping the price of opium artificially low by the ex-Opium Monopoly Department due to World War II. Consequently farmers created contraband opium sales and in collusion with Government agents misreported their cultivated area and the production of opium.

Purchase data from the ex-Opium Monopoly Department shows that the average annual production during the years 1943-55 in the region was 24.6 tons or 13.84 per cent of the total production of the country; the rial value being 12.8 millions or 15.66 per cent of the country's total figure.

As the cultivation of wheat and barley requires the same quantity of water as opium, it can easily replace the latter, and so recover the loss resulting from the abrogation of opium cultivation. We shall therefore study here the changes in production of these two crops from the years 1923-33, and the years 1957 and 1960.

The expansion of the cultivated area and the production of wheat and barley has continued to prevail in the whole district so far studied, (as mentioned in issues nos. 9 and 10 of « Tahqiqat e Eqtesadi » section: re-abrogation of opium cultivation). This expansion is partly due to the increase in population, so only a part of it can be said to compensate for the loss sustained from the abrogation of opium cultivation. The increase in the cultivated areas in proportion to population growth has been observed in areas such as Zanjan and Khuzistan where opium production was not customary.

Therefore, for the study of this subject it is necessary to know the changes in population and production during the recent 35 years in Zanjan and Khuzistan (i.e. in four townships: Shushar, Dezful, Ramhormoz and Behbahan of Kohkiluyeh), and Isfahan and district 2 of province 6. The Gilan region, where wheat and barley are not considered principal crops, is left

Table 26

Population changes and production of wheat and barley in various regions during the 35 year period

District	Years 1926 - 1933		Within recent years		Percentage of increase of population during 35 years	Percentage of production increase during 35 years
	Population	Production in tons	Population	Production in tons		
Zanjan and four townships of Khuzistan	328,152	149,282	573,221 *	203,725	75	36
Isfahan **	560,839	112,861	1,045,205	139,317	86	23
District 2 province 6	279,613	101,462	627,738	288,001	124	184

* This figure includes the 1957 Zanjan population and the population of the 4 townships of Khuzistan as obtained in 1960 by the General Department of Population Statistics(G.D.P.S.)

The wheat and barley production during «the recent years» in Zanjan is the 1957-60 average obtained by the G. D. P. S ., and in the 4 townships it is the average of the 1958-60 data of the G. D. P. S. and that of the Ministry of Agriculture collected in 1957.

** The population and production of Isfahan and district 2, of province 6 for «recent years» is the average 1957 data of the Ministry of Agriculture and that of 1960 of the G. D. P.S.

out of this study. If in the two districts of Khuzistan and Zanjan, where there is no record of opium cultivation, the average increase of population and the production of wheat and barley within the given period are computed by using these average percentages, and also the percentage of population increase in Isfahan and district 2 of province 6, we shall be able to obtain for the two latter districts the percentage increase in wheat and barley production corresponding with the increase in population in comparison with Zanjan and Khuzistan. In order to arrive at this objective, Table 26 was formulated.

As can be seen from this table, the average increase in population in Zanjan and Khuzistan inside 35 years was 75 per cent and the increase in the production of wheat and barley was 36 per cent.

With due consideration to the above table and using the method already stated for Isfahan, we shall have the following:

Average production increase	Average population increase
36	75 per cent in Zanjan and Khuzistan
x equals 41	86 per cent in Isfahan

This means that Isfahan, in comparison with Zanjan and Khuzistan, should have an increase of production of 41 per cent, parallel with its 86 per cent population increase. In Table 26 it is seen that the increase of production in Isfahan was only 23 per cent. Therefore, in this region the increase in the production of wheat and barley is not even commensurate with the population growth. It is evident that Isfahan has not been able to recover the loss it suffered due to the abrogation of opium cultivation. In the same manner for district 2, province 6, we shall have:

Average production increase	Average population increase
36	75 per cent Zanjan and Khuzistan
x equals 59	124 in district 2, province 6

Thus, this district in comparison with Zanjan and Khuzistan should have had an increase of 59 per cent in production of wheat and barley to cope with the 124 per cent growth in population. But wheat and barley increases in this district were 184 per cent; therefore, it can be said that the

difference between these two; namely, 184-59 equals 125 per cent; is likely to compensate for the loss resulting from the abrogation of opium cultivation.

In general, this increase of 125 per cent of wheat and barley is equal to tons 126, 725, the corresponding increase of income being Rls. 407,526,938. Therefore it can be seen that the decrease of the income resulting from the abrogation of opium cultivation in district 2, province 6 is only 3.11 per cent, so the loss has been virtually recovered.

Part IX. Composition of Various Factors in Production of Crops

In this part we shall discuss the following subjects:

1. Calculation of crop share in kind per head of population for grain, it's changes in 35 years, and the comparison of the rate of production increase with that of population in district 2, province 6, as well as the other districts studied.

2. Production quantity, and value of grain, and the changes in 35 years in the said district, and how it compares with other districts studied.

3. Production quantity, and value of other crops, and the changes in 35 years in this and other districts studied.

4. Comparison of the cultivated area of wheat, barley and rice in district 2, province 6, and other localities, with the total cultivated area and production of the country.

5. Study of ratios: $\frac{\text{Population}}{\text{cultivated area}}$, $\frac{\text{Production}}{\text{cultivated area}}$ and $\frac{\text{Production value}}{\text{cultivated area}}$ in district 2, province 6, and comparison of these parameters with similar ratios in the districts already studied.

6. Income accrued from annual crops and fodder crops in this district, changes of these in 35 years, their comparison with similar parameters in other districts, and calculation of per capita income resulting from annual crops.

1. Calculation of per capita income from grain production and the study of changes and comparison of production increase, and that of population in district 2, province 6, with that of other districts so far studied

For the study of this subject, i.e., production of grain during 1926-1933, and the average for 1957 and 1960, and similarly the total population of

the district extracted from the same report with corresponding figures for other districts studied; we have formulated Tables 27 (a and b).

From Table 27 we obtain the following results:

a. Among the locations so far under consideration, the only district where the percentage of increase in grain production exceeds that of the population, is district 2, province 6. If we take the consumption of wheat per person as 150 kgs. per head per annum [1] it will be seen that the district has had an increase of 237 kgs. of wheat per person during the last 35 years. The present excess over consumption of grain has mounted to 357 kgs. as compared with that of 35 years ago.

b. In Zanjan and some parts of Khuzistan; i.e. Behbahan of Kohkiluyeh, Ramhormoz, Dezful and Shushtar; the rate of population growth has exceeded the increase in grain production. However, in Zanjan, with 251 kgs., and Khuzistan with 388 kgs. per capita production 35 years ago, there has been an excess of production over consumption.

In Zanjan now, the production of wheat is 210 kgs. and in Khuzistan 349 kgs. per head, which means an excess over consumption. But production on the whole has decreased as compared with 35 years ago.

c. In Gilan the production of wheat takes place in cool areas. And as the population figures for these areas were not known, we had to divide the production of wheat by the total population of Gilan. We do admit that this calculation is not accurate.

In addition to wheat, rice and millet are consumed in the cool areas of Gilan and rice in the warm areas. It can therefore be said that the probable shortage of wheat is met by rice and millet, a considerable quantity of the former being sent to other provinces in order to cover the shortage of grain.

d. Forty years ago in Isfahan, the per capita production of wheat was 92 kgs. Then there was a shortage of consumption, and today with 78 kgs. this shortage has further aggravated.

1. According to the Research Group on Barriers to Economic Development of Iran, the consumption, as well as export and import of wheat during the year 1957, amounted to 157 kgs. per head. On the other hand, in the book written by Haji Mirza Ali Djanab under the title «Book of Isfahan» p.181-187, in 1923 the figure was estimated as 147 kgs. per head per annum. Therefore we have reckoned 150 kgs. as an average consumption per head.

e. In order to calculate the excess or shortage of wheat production as compared with consumption in various districts studied, we have formulated Table 28, taking into account the population, 150 kgs. as annual consumption per head, and the production of wheat in 1957 and 1960[1].

Table 27 b

Comparison of grain production increase with population growth

Name of district	Percentage of production increase of grain and contribution of each crop to the increase				Percentage of Population Growth
	Total grain	Wheat	Barley	Rice	
District 2, province 6	+176. 0	+160.6	+17. 6	-2.3	+116. 9
4 townships of Khuzistan	+28. 7	+33. 2	— 1. 0	-3. 5	+84. 1
Zanjan	+29. 5	+28. 9	+0. 018	+ 0. 5	+63. 7
Gilan	+88. 8	+2. 08	— 0. 07	+86. 8	+105. 9
Isfahan	+23. 63	+27. 4	+5. 07	+1. 26	+70. 7

Table 28

Comparison of wheat production and consumption, to indicate surplus or deficit in various districts

Name of district	Population between 1956-1960	Consumption of wheat in tons	Average production during 1957 and 1960 in tons	Surplus or deficit in tons
District 2, province 6	679071	101860.7	242326.0	+140465.3
Zanjan	370344	55551. 6	77661. 0	+22109. 4
4 townships of Khuzistan	250769	37615. 4	87442. 0	+49826. 6
Other localities in Khuzistan	371767	55765	73529. 0	+17764. 0
Isfahan	1363416	204512. 4	106037. 0	— 98475. 4
Total	3035367	455305. 1	586995. 0	+131689. 9

Figures in Table 28 show that the production of grain in Khuzistan, Zanjan and district 2, province 6, was such that it not only covered the grain deficiency of Isfahan, but produced an additional surplus, which might have been used to overcome shortages in other districts not studied by the group.

But the slower increase in production rate in comparison with that of population growth in Zanjan, as well as in the four townships of Khuzistan (according to Table 27 b), during the recent 35 years, does not show a promising furture. Among the localities studied, only district 2, province 6, may have surplus production over consumption for some years to come.

f. Areas such as district 2, province 6, where the grain production increase is higher than population growth, due to the ability to cope with grain deficits in other localities, are important and should be studied for two reasons :

Firstly to ascertain what other localities in Iran are in a similar position and whether their surplus grain can meet shortages in other areas, and whether all such localities are in a position to cover grain shortage of the total population of the country. As the economy of grain in other provinces is gradually studied, these questions will also be solved. Furthermore, it will be made clear in district 2, province 6, and other localities where increase of grain production exceeds the increase of population, which agricultural characteristics prevail and whether it is possible to overcome grain shortage by creating similar conditions in other areas.

Generally, the grain production increase in the country is accomplished in two ways; either by expanding the cultivated area or by raising the yield per unit area. As the selection of any or both of these ways more or less depends on the type of farming, we have shown the dry and wet farming of grain in various places in Table 29. A glance at this table will show:

In the case of wheat and barley, production increase has mostly taken place in dry-farmed fields rather than in the wet-farmed; so that, out of a 73 per cent increase in the total production, 47 per cent is of dry-farmed and 26 per cent of wet-farmed land.

The wet-farmed production of wheat and barley has also had an increase, but due to an insufficiency of water the increase has been about half that of the dry-farmed areas.

By referring to Table 30 it will be seen that the yield in various areas in the recent 35 years, with the exception of those reported by the Ministry of Agriculture, which seem to be over-estimated, has produced no striking change. It can be said that the production increase, whether in wet or dry farming, has been achieved largely through the increase in cultivated area rather than by fertilization of the soil and the corresponding increase in the yield per unit area.

To vitalize land for dry-farming one should bear in mind that when the soil fertility is raised, the foliage, and consequently the need for water, is increased.

Therefore, the enriching of soil for increased production in dry-farmed areas can only be aimed at in localities where sufficient rainfall is expected; like Khorramabad with an annual precipitation of 500 mm's.; and where there is no risk of crops being scorched by drought. In other areas where the rainfall is less than 500 mm's, the fertilization of soil for dry farming should be done carefully by the use of organic or mineral composts, including green fertilizer with dry-farmed peas introduced alternatively in the crop rotation. In places such as Khorramabad, where annual rainfall is more and there is no danger of drought, the production of dry-farmed grain can be increased both by making the soil fertile and by expanding the cultivated area. But in locations where less precipitation exists the production can be augmented through the expansion of the cultivated area, provided that the value of production could amortize the expenditure incurred. As already mentioned, in the case of wet farming also, according to Table 30, the yields in the last 35 years shows no increase. Therefore, in this case too, the production increase has been accomplished through an expansion of the cultivated area. In district 2, province 6 and in Isfahan, however, the abundance of water has resulted in a greater increase in the cultivated area, and therefore the production has exceeded that in other districts,such as Zanjan and Khuzistan[1].

In wet farming in general, an attempt should be made to expand the cultivation area in conjunction with water sources and to raise the yield by

1. The Study of Khuzistan similar as in other localities, covers the period ending in 1960 effects of water increase before the construction of the dam which was not appeared,

means of organic and mineral fertilizers so as to make the utmost use of existing water supplies. In the light of what was mentioned in part V, fertilization and farming according to scientific techniques cause production increase per hectare, but at the same time increase the foliage and consequently the evaporation; therefore more water will be needed.

According to calculations made in the same area however, in spite of the use of more water in areas of dense cultivation, water consumption for obtaining a given quantity of product is less than that used for thin and sparsely cultivated plants.

Therefore, in wet farming it is of primary importance to make the land more productive through fertilization and improved farming techniques so that the utmost benefit can be derived from the expensive water available.

2. **Production of grain and changes in 35 years in district 2, province 6 and its comparison with other districts studied:**

To determine the increase or decrease in production of grain and its value in this and other districts studied, we have formulated Table 31.

From Table 31, we obtain the following results:

a. In district 2, province 6, production of wheat and barley during the recent 35 years has increased by 183 per cent. This excess production is so much that even after compensating for the stagnant price of wheat and barley, its value shows an increase of 65 per cent; whereas, according to the said table, in spite of the rise in wheat and barley production in Zanjan as well as in the four townships of Khuzistan, Isfahan and Gilan, due to the depressed prices of these crops; the total value of their grain production has fallen as compared with the past.

b. As mentioned in the section concerning the abrogation of opium in district 2, province 6, the 65 per cent increase in the production value of wheat and barley, in addition to having provided for the consumption of the increased population in the district, has virtually covered the loss resulting from the opium prohibition (refer to part 8 of this report).

c. As repeatedly mentioned on several occasions, due to the surplus production of rice in Gilan and it's high price, the value of production of rice has been augmented by 98 per cent.

3. **Production of other crops and their changes during the years in this and other districts studied** 35

For the study of this we formulated Table 32. The study of this table shows that:

a. Against 117 per cent population increase in district 2, province 6, production of «other crops» has increased by 147 per cent (with an 87 per cent rise in their value). Here, as in the case of grain, the rate of production increase has been higher than that of population.

But for the 147 per cent production increase (Table 3), we have only obtained an 85 per cent increase in the corresponding value; therefore the percentage increase in the value of production of other crops has lagged behind the rate of population growth.

b. Due to the expansion of summer crops the increase in the value of production has been ahead of that of population in Zanjan and Gilan; but in Isfahan, due to the abrogation of opium, the decrease in the area under tobacco cultivation, and the stagnant state of its price, the increase of production value has been limited to 18 per cent, while the population has increased by 70 per cent.

4. **Comparison of the cultivated area and production of wheat, barley, rice and other crops in district 2, province 6, and other localities with the total cultivated area and production of the country**

For this study, Table 33 has been drawn up, from which we draw the following conclusions:

a. Among the localities studied for wheat and barley, district 2, province 6, ranks first for production and the second for size of cultivated area in the whole country.

b. Compared with the cultivated area and production of other crops in the country, it ranks fourth and third respectively among the five districts.

c. If we consider the ratio of the yield of every district to the average yield of the country, we shall see that Isfahan, with a ratio of $\frac{4.78}{2.32} = 2.06$ ranks first, Gilan with $\frac{5.75}{3.64} = 1.57$ ranks second, district 2, province

6, $\frac{4.61}{4.30} = 1.07$ ranks third, Zanjan $\frac{1.86}{2.09} = 0.88$ ranks fourth and the hot region of province 6 with a rate of $\frac{5.91}{7.37} = 0.80$ ranks fifth. It is evident that tlfe yield in Isfahan, Gilan and district 2, province 6, is higher, and in Zanjan and the hot regions of province 6 it is lower than the average for the country.

In other words, cultivation in the two latter districts is more primitive than in the other three districts.

This subject is elaborated further in Paragraph 5 below:

5. **A study of the ratios of $\frac{\text{Population}}{\text{Cultivated area}}$, $\frac{\text{Production}}{\text{Cultivated area}}$ and value of production cultivated in district 2, province 6, and comparison of these parameters with those in the districts studied**

In order to measure the efficiency of farming in this district, the computation of the above ratios, which consist of population density per cultivated unit area, yield per unit area and value of production per unit area seems to be helpful. For determining these three parameters and comparing them with similar factors in the districts studied, Table 38 in the issue nos: 9 and 10 of « Tahqiqat e Eqtesadi » has been reconstructed here with figures relating to district 2 province 6 also included to form Table 34.

The following conclusions are derived from Table 34:

a. Isfahan, with a density of 7 persons per hectare of cultivated area and a yield of 2.56 per hectare ranks first among the country's regions from the viewpoint of farming technique; followed by Gilan with3.6 persons per unit of cultivated area and a yield of 1.97 per hectare; district 2, province 6, witb 2.26 persons per unit of cultivated area and a yield of 1.33 hectare, being the third.

Khuzistan and Zanjan, with population densities of 1.83 and 1.48 persons per unit of cultivated area, and a yield of 0.58 and 0.64 per hectare respectively are identical, and ranks fourth.

Therefore, the farming of these two districts is considered relatively backward as compared to the other three districts.

b. Owing to the fact that rice constitutes the principal crop of Gilan and that its price has increased relatively, this province, with a production of rials 21,197 per hectare in 1960 and rials 19,557 (by the current rate of rial) in the years between 1926-1933, ranks first: its production value per hectare having remained constant in the last 34 years.

c. According to what was mentioned in paragraph (a), Isfahan from the point of view of population as well as production ranks first. But with a production value of rials 11,694 per hectare in 1960 and rials 19,557 in 1926-33 it ranked second. Because of various reasons such as the reduction of wheat and barley prices and the losses caused by the abrogation of opium etc.; its production value per hectare has dropped in the last 35 years.

d. District 2, province 6, with a production value of Rls.9,154 in the 35 years (by current rial value), and Rls.6,524 in 1960 (or almost one half of that of Isfahan) occupied the third place.

Production value of this district has declined by 1/3 in the last 53 years, due to the fact that prices of wheat and barley have remained lower than the price index.

6. **Income resulting from annual crops and fodder crops of this district, the changes of 35 years of these parameters, its comparison with similar parameters in other districts and computation of per capita income accrued from annual crops**

According to Table 3 of this report, the income of the district under study from crops; excluding that from cattle breeding, trees and other agricultural income; between 1926-33 was about rials 42,366,616, which by the present rial value will be 1,372,678,358. The average of this income for 1957 and 1960 is approximately Rls. 2,126,016,390. Therefore the agricultural income of this district shows an increase of Rls. 753,338,032.

By considering the figures of Table 3, the reason for this increase can be explained as follows:

Though rice production has fallen in this district, the price of tobacco, wheat and barley has remained lower than the price index, opium production has been abolished and the price and production of fodder plants has decreased; yet the increase in wheat and barley production by 186,539

tons, i.e. three times the previous production, and the adoption in recent years of new agricultural crops,i.e., sugar which has an income of rials 10,981, 200, and the increase in price of melons, cucumbers, potatoes etc.; have caused the annual income from all crops in the district to rise by as much as 1.5 times during the last 35 years.

For comparison of the income from annual crops of this district with that of similar regions, Table 35 has been drawn up.

By considering the figures in this Table, the following results are obtained:

a. After Gilan, where the agricultural income has doubled in 35 years, district 2, province 6, follows with an 8 per cent increase in agricultural income. It should, however, be remembered that, whatever has been mentioned in part VII on « Labour and Energy», the increase of income from annual crops in Gilan has been coupled with the expansion of the cultivated area and production per ox; consequently, the farmers have had a rise in their income and a corresponding amelioration of their living conditions. On the other hand, the 8 per cent increase in income from annual crops of the district 2, province 6, has been effected through the addition of oxen.

Therefore, the farmers have not only failed to have an extra income, but due to the reduction in the cultivated area, production per ox and its value, they have sustained some losses in this respect.

b. In other districts studied, i.e. Zanjan, Khuzistan and Isfahan, income from annual crops has declined, the reason for which has been mentioned in previous reports.

c. Per capita agricultural income of this district from annual crops in 1960 (without that of cattle breeding and trees), equals Rls. 2,111, which, as compared with other districts ranks third after Gilan, and Khuzistan, Isfahan and Zanjan in this respect rank filth and sixth respectively.