Report of the

HELMAND RIVER

DELTA COMMISSION

Afghanistan and Iran

February 1951

Letter of Transmittal

The Helmand River Delta Commission has the honor to transmit its report on the water-supply problem in the Helmand River Delta to the Royal Government of Afghanistan and to the Imperial Government of Iran.

Following the appointment of the Helmand River Delta Commission in September 1950, the Commission convened in Washington, D.C., on October 6. After a short briefing on the problem the Commission departed for Asia, where an equal period of time was spent in reviewing the problem on the ground in both Iran and Afghanistan.

The Heads of Governments in both countries as well as their officials who were most familiar with the problem were consulted. In their travels through each country, the Commissioners also had the opportunity of discussing the various local irrigation troubles with the farmers in the Helmand River Delta on both sides of the border.

Upon its return to Washington early in December, the Commission immediately undertook the preparation of this report. It is the hope of the Commission that the material contained herein, together with the recommendations and suggestions for mutual accord, will form the basis for a satisfactory and lasting agreement for the distribution of the Helmand River water in the Delta between the two nations.

The Commission desires to commend and acknowledge the work of Mr. Malcolm H. Jones, whose assistance has been outstanding, first as Engineer-Factfinder and subsequently as Engineer-Secretary.

Francisco J. Dominguez

FRANCISCO J. DOMINGUEZ, *Commissioner*

Robert L. Lowry

ROBERT L. LOWRY, *Commissioner*

Christopher E. Webb

CHRISTOPHER E. WEBB, *Commissioner*

Washington, D. C.
February 28, 1951

Foreword

The Helmand River Delta Commission, composed of three neutral hydraulic and irrigation specialists selected by the two Governments, was created to deal with the problem of distribution of the Helmand River water between Afghanistan and Iran. Both countries have now agreed to consider the report of this neutral technical Commission, which has been instructed to provide an engineering basis for the negotiation and settlement of the problem. The Commission believes that an engineering basis for the settlement of the problem is set forth in the following report. Free use has been made of the technical data in reports of previous commissions, as provided for in the Terms of Reference. This Commission is of the opinion that the two Governments can obtain the most satisfactory solution of this international problem if a new process of negotiation be undertaken, using the engineering facts presented in this report as the basis.

Acknowledgments

The Helmand River Delta Commission was graciously received in Kabul and in Tehran by the Heads of Government and by the top ranking officials concerned with this problem. The officials of both Governments sincerely aided the Commission in its investigations and studies.

The field studies of the Helmand River in Afghanistan and in Iran were greatly facilitated by the high ranking personnel assigned by each Government as official representatives. The Commission wishes to commend especially the efforts of H. E. Abdul Madjid Khan, President, Afghan National Bank, and formerly Minister of National Economy, and H. E. Najib-Ullah Khan, Afghan Ambassador to India, who not only represented the Government of Afghanistan but served as hosts to the Commission during the journey through Afghanistan. The Commission also wishes to commend the efforts of H. E. Khoxeime Alam, Deputy to the Majlis, Iran, who not only officially represented his Government during the Commission's operations in Iran but served as host throughout the Commission's stay in that country.

The Commission appreciates the friendly spirit of cooperation and genuine hospitality evidenced by the officials in Afghanistan and Iran, and by the diplomatic corps of both countries in each place visited, as well as in Washington, D.C.

CHAPTER I

Authority for the Commission

1. The fertile lands of the Helmand River Delta, surrounded by the deserts of eastern Iran and western Afghanistan, have been irrigated for many centuries, through the comparative abundance of water brought by the Helmand River (known also in Iran as the Hirmand) from the distant high mountains of central Afghanistan. As is characteristic of desert streams, the use of this water on the lands along both sides of the river has many times been the cause of argument and strife concerning its ownership. The problem of the division of the waters of the Helmand River in its Delta became international with the definition of the Afghan-Iranian boundary in 1872. Throughout the succeeding years various efforts have been made to reach an agreement regarding the distribution and use of these waters.

2. The occurrence of a critical drought in the summer of 1947 and the initiation of upstream developments by the Government of Afghanistan precipitated the question anew, and set in motion another effort by the Governments of Afghanistan and Iran to find a basis for mutual understanding and agreement on the

Helmand River Delta water problem. The United States Department of State tendered its good offices in October 1947 and conversations were soon initiated between representatives of Afghanistan and Iran in Washington, D.C. In February 1948 the United States Department of State suggested that a three-man neutral technical commission be selected by Iran and Afghanistan to study the problem and recommend a basis for settlement. It was later suggested that a United States water technician be loaned to serve as Engineer-Factfinder in Iran and Afghanistan and to prepare the data for the use of the neutral technical commission. This proposal being accepted by both Governments, an engineer from the United States Bureau of Reclamation was approved in January 1950 as Engineer-Factfinder and his work was soon initiated. With the full cooperation of both Governments this engineer accomplished during the spring and summer of 1950 the preparatory work for the proposed commission.

3. From the latter part of 1948 both Governments were considering a panel of water experts from many countries from which to select the commissioners. Three experts were formally agreed upon by both countries in March 1950, and the neutral commission to be later known as the Helmand River Delta Commission was composed as follows:

FRANCISCO J. DOMINGUEZ, *Professor of the Universidad de Chile and the Universidad Catolica de Chile, Santiago, Chile. Chief of the Irrigation Department of the Corporacion de Fomento, Chile*

ROBERT L. LOWRY, *Consulting Engineer, El Paso, Texas, United States of America*

CHRISTOPHER E. WEBB, *District Engineer, Water Resources Division, Department of Resources Development, Vancouver, British Columbia, Canada*

4. In August 1950 representatives of the two Governments initiated conferences in Washington, D.C., to define the task of this neutral Commission. The conferees completed their work on September 7, 1950, and, in accordance with the Terms of Reference thus established, the selected water experts were summoned by concurrence of the two Governments to meet in Washington early in October 1950. The Commission left immediately for Afghanistan and Iran, spending 3 weeks in each country.

5. The Terms of Reference of the Commission and an interpretative statement relative thereto, agreed by the Afghan-Iranian conferees on September 7, 1950, are as follows:

TERMS OF REFERENCE

Helmand River Delta Commission

Purpose

To recommend to the Governments of Afghanistan and Iran an engineering basis for mutual accord regarding the apportionment of the waters of the Helmand River (known in Iran as the Hirmand), at or below Band-i-Kamal Khan for use in Seistan, Iran and Chakhansur, Afghanistan.

Designation

This Commission shall be known as the Helmand River Delta Commission.

Organization

The Commission shall consist of three engineers from three disinterested countries, expert in the management of water resources in arid regions, who shall be mutually acceptable to Afghanistan and Iran. In the Commission's investigations and deliberations, the Commissioners shall serve as individual professional men and not as representatives of the countries of which they are nationals or of any other country.

Functions

a. The Commission shall collect and study available data relative to:

(1) stream flow of the Helmand River at or below Band-i-Kamal Khan, including annual and long-range cycles of drought, normal flow, and flood;

(2) past and present uses of the waters of the Helmand River in the delta area (e.g. Iranian Seistan and Afghan Chakhansur), including a study of the land under cultivation in the delta area;

(3) existing works in the delta area for control or diversion of the waters of the river;

(4) plans for new installations and methods which might result in a more scientific use of available water in the delta area.

b. The Commission shall review prior reports and documents (including those of Goldsmid and McMahon) pertaining to the apportionment of the waters of the Helmand River between Iran (Persia) and Afghanistan. The Commission shall study available reports and records of officials and engineers of Iran or Afghanistan, or of engineers who are or have been employed by either country, or pertinent records in other countries. The Governments of Iran and Afghanistan shall supply to the Executive Secretary before the first meeting of the Commission or to the Commissioners during their sessions in the respective countries available reports and records for study by the Commission, but supplying such materials shall not be considered as establishing a precedent.

c. The Commission shall recommend the technical methods by which the share of the water of the Helmand River to which Iran may be entitled, pursuant to the terms of such mutual accord as may be reached, may be allocated to Iran at or below Band-i-Kamal Khan.

d. The Commission shall present its findings and recommendations to the Governments of Iran and Afghanistan. The findings and recommendations of the Commission shall be advisory only.

In the event that the available data is insufficient for reasonable definition of an engineering basis for mutual accord between Afghanistan and Iran regarding the waters of the Helmand, the findings and recommendations shall present a program for collection and development of the requisite engineering data.

Operations

The Commission—The three Commissioners shall constitute the Commission. The Commission shall adopt its own rules of procedure, choose its own presiding officer, and have authority to direct staff and operations.

Engineer-Secretary—To facilitate the organization and work of the Commission, Afghanistan and Iran shall agree upon an engineer-secretary, recommended by the United States Department of State, to serve as Executive-Secretary for the Commission and as engineer fact-finder in the initial collection and presentation to the Commission of available facts and data.

Assistants—Each Commissioner shall be entitled to select an engineering assistant to make studies, if such assistants are regarded as essential by the Commissioners. The said assistants to the Commissioners, if appointed, shall be nationals of neither Iran nor Afghanistan.

Meetings—It is contemplated that the Commissioners will meet as soon as possible after an initial "fact-finding" report can be completed and submitted to the Commission by the Engineer-Secretary. They will continue working together until the Commission has submitted its report to Afghanistan and Iran. Subsequent meetings may be held if requested by the Governments of Iran and Afghanistan.

Consultation—The Commissioners will be fully advised by the Engineer-Secretary as to his intended operations on their behalf in order that they may advise thereon. Time which the Commissioners devote to study and preparation for the Commission's meetings shall be recorded for the purpose of compensation.

Local Assistance—Interpreters and other assistants, together with adequate transportation, as may be required by the Commission during its operations in the countries concerned, shall be furnished by the respective countries. Technical observers of Afghanistan may accompany the Commission in Afghanistan and technical observers of Iran may accompany the Commission in Iran, if the Commission so requests.

Correspondence—Copies of the official correspondence and the report of the Commission with either of the two countries will be made available only to the Governments of Afghanistan, Iran, and the United States, and such correspondence together with the official report of the Commission will be delivered to the respective countries at such Embassy or other place as they may specify.

Language—The report of the Commission and the correspondence of the Commission shall be in the English language, which shall be authoritative.

Agreed by conferees of Afghanistan and Iran, September 7, 1950.

INTERPRETATIVE STATEMENT

to be Read with the Terms of Reference for the Helmand River Delta Commission

(This statement was read into the record by an officer of the U.S. Department of State at the meeting on September 7, 1950, of representatives of Afghanistan and Iran to establish Terms of Reference for the Helmand River Delta Commission.)

The Department of State appreciates the close attention and cooperative effort of both sides in their desire to reach an agreement on the Terms of Reference. Persistent efforts have been made since September 1 to reduce remaining differences to such limits that they may be reconciled and final agreement reached today on the Terms of Reference, in order to permit the activation of the Commission and to allow it to depart for the field this year. The Department is sure both parties appreciate the numerous difficulties and the increased expense which would be involved in further postponement.

It is believed, on the basis of informal discussions with both parties, that agreement is possible on the draft known as Column C of the working chart plus the section "Operations" already agreed. It is further believed that both sides agree in principle as follows:

(1) It is the intent of both parties as expressed in these meetings that the Commission shall travel freely as required to accomplish its purpose.

(2) Further in accordance with the understanding previously reached (August 30) it is agreed that the first sentence of paragraph *b* "Functions" shall be amended to read:

> "The Commission shall review prior reports and documents (including those of Goldsmid and McMahon) pertaining to the apportionment of the waters of the Helmand River between Iran (Persia) and Afghanistan."

Further, the Department understands that the language of Section *b* under "Functions" shall be read without prejudice to the positions of either Government regarding the validity of the findings of Goldsmid and McMahon.

(3) It is the intention of both parties that the Commission shall determine what quantities of water have in the past and do at present reach the delta area and shall study the effect on the quantities of water reaching the delta area of works now existing, in construction or in present contemplation. It is understood that

this is provided for by items *a* (1) and *a* (4) under "Functions." This shall be a factual study for reference to both parties, who may then seek through direct negotiation or adjudication an agreement for appropriate allocation of the waters of the river for use in Iranian Seistan and Afghan Chakhansur. A safeguard to the interests of both countries is clearly provided in Section D under "Functions", which states that "the findings and recommendations of the Commission shall be advisory only".

On the basis of the foregoing the Department hopes that the representatives of the two Governments will find that adequate safeguards are provided for their respective interests and will find it possible to accept the draft proposal C plus the Section "Operations" already agreed upon as the Terms of Reference for the Commission.

Accepted by both delegations September 7, 1950.

CHAPTER II

The Problem

6. The purpose for which the Helmand River Delta Commission was set up is defined in the opening paragraph of the Terms of Reference as follows:

> Purpose: To recommend to the Governments of Afghanistan and Iran an engineering basis for mutual accord regarding the apportionment of the waters of the Helmand River (known in Iran as the Hirmand), at or below Band-i-Kamal Khan for use in Seistan, Iran and Chakhansur, Afghanistan.

and expanded under "Functions" in the Terms of Reference:

> c. The Commission shall recommend the technical methods by which the share of the water of the Helmand River to which Iran may be entitled, pursuant to the terms of such mutual accord as may be reached, may be allocated to Iran at or below Band-i-Kamal Khan.

7. As indicated in the foregoing, the major purpose of this Commission is to furnish an engineering basis for the settlement of the water problem between the two countries.

8. Problems of the division of water for irrigation have been recurring at intervals during many centuries in the Delta. Existing remains of habitation indicate clearly that the land in the delta area has been cultivated almost continuously during a great many generations. In 1872 the local problem was changed to

an international problem by the boundary award of General Goldsmid. Each successive drought, with its consequent shortage of water, has aggravated the situation. There is historical evidence to show that all of the difficulties over the distribution of water in the Delta were not necessarily caused by shortages of water. The great channel changes which are still plainly indicated on the ground must have deprived some villages of water to the advantage of other areas which became new centers of population in the Delta. The conflicting interests that resulted have not always been amicably settled. The establishment of a basis of understanding on the river, in order that present and future problems arising from the use of these waters in two countries may be equitably and peacefully settled, is the broad aim for which this Commission was created.

9. It is to be hoped that the assembly of facts concerning the acreage that has actually been irrigated in the past and in recent years on both sides of the Delta; the compilation of reliable data on the quantities of water that have reached the Delta, both in the past and more recently; as well as engineering estimates of past and present uses of water in the Delta, may lay the foundation stones upon which an equitable apportionment of the waters of the Helmand River can be developed.

10. If the representatives of the two countries will meet each other with the mutual respect that was apparent throughout their

dealings with the Commission while it was in their midst, there is every reason to believe that this problem may be dealt with amicably to the satisfaction of both nations. An agreement based on engineering facts and reached around the conference table has a much better chance of enduring than an agreement reached by any other method.

CHAPTER III

Background of the Problem

Prior International Negotiations

11. The problem of the division of the waters of the Helmand River in the delta area of that river has undoubtedly existed throughout many centuries. The problem was first raised to an international level in 1872, when the British were requested to arbitrate the dispute between Persia (now Iran) and Afghanistan over the ownership of the Seistan area. The establishment of an international boundary by this mission transferred the problem of the division of waters in the Delta from the local villages and local governments to the Governments of the two nations. In his arbitral award (Appendix I), issued at Tehran August 19, 1872, Major General Sir Frederic Goldsmid acknowledged the problem of the water of the Helmand River in the following terms:

> It is moreover to be well understood that no works are to be carried out on either side calculated to interfere with the requisite supply of water for irrigation on the banks of the Helmand.

12. Subsequent to the issuance of this arbitral award in 1872, such disputes as may have arisen in the following 30 years concerning the waters of the Helmand River in its delta area

appear to have been settled amicably by the skillful negotiation of the local officials. However, channel changes in this area and the occurrence of a severe drought in 1902 raised the question again and brought about a second attempt at settlement of the problem by arbitration under the British Government. This effort was carried out by the Perso-Afghan Arbitration Commission, 1902–1905, under the direction of the British Commissioner, Colonel A. H. McMahon. The Mission (hereinafter referred to as the McMahon Mission) conducted field investigations in the Helmand River Delta from February 1903 to May 1905. On April 10, 1905, the Commissioner, Col. McMahon, issued his arbitral award on the Seistan water question at Camp Kohak (Appendix II). In 1906 the detailed field reports prepared by staff officers of the McMahon Mission were published. Herein these reports, which are separate from the McMahon Award, will be termed the McMahon Reports.[1] Apparently no major difference of opinion regarding the waters of the Helmand River in its delta area arose in the years immediately succeeding the issuance of the award of Col. McMahon, as no efforts to implement the award are re-

[1] The McMahon Reports are:

Seistan Irrigation Report of the Perso-Afghan Arbitration Commission 1902–1905, volume I, hereinafter called Seistan Irrigation Report, vol. I.

Seistan Irrigation Report of the Perso-Afghan Arbitration Commission 1902–1905, volume II, hereinafter called Seistan Irrigation Report, vol. II.

Seistan Revenue Report and Notes of the Perso-Afghan Arbitration Commission 1902–1905, volumes I, II, and III, hereinafter called Seistan Revenue Report, vols. I, II, and III.

corded. This McMahon arbitration did not prove entirely successful, as the award has been disclaimed by the Government of Iran. However, both the Government of Afghanistan and the Government of Iran in the present-day negotiations have given recognition to the basic engineering data assembled by the McMahon Mission.

13. During the decade 1920–1930 further disagreements arose. The attention of both Governments to the problem of the water supply of the Helmand River Delta is noted in 1931–1932, when joint Afghan-Iranian teams met to divide the flow of the Helmand River in the Delta. In the immediately succeeding years efforts were directed toward a new agreement regarding the apportionment of the low flow of the river. These efforts lapsed about 1939, as a satisfactory basis for agreement had not been found. During the period of these negotiations it appears that, primarily by mutual consent of the operating officials, the low flows of the river reaching the head of the Delta near Band-i-Kamal Khan were divided satisfactorily between the two countries.

14. The occurrence of another critical drought in the summer of 1947 and the initiation of upstream developments by the Government of Afghanistan caused renewed efforts to find a basis for mutual understanding on the Helmand River water problem. Negotiations by the Governments of Afghanistan and Iran led

to the formation in October 1950 of the present neutral, advisory Helmand River Delta Commission.

Presentation of Data to the Commission in 1950

15. During 1950 the Government of Iran furnished such basic data as were available in regard to the water problem in Seistan to the Engineer-Factfinder for the consideration of the Helmand River Delta Commission. The Commission has taken particular note of a paper thus transmitted in February 1950 entitled "Irrigation Water Required Annually in Seistan," which presents a technical approach to this problem. Under date of September 14, 1950, Dr. Gholam-Hosseine Khochbine advised the Engineer-Secretary of the Commission by letter (Appendix III) that he and Ghodratollah Tashakkori had just completed a report "upon the question of apportionment of the waters of the Hirmand River." That report, entitled "The Hirmand River Dispute," which is based to some extent on the McMahon reports, has been reviewed by this Commission. While this Commission was studying the Helmand River problem in Seistan, Iran, in November 1950, Mr. Tashakkori discussed with the Commission various phases of the water problem including the report "The Hirmand River Dispute." He emphasized that it is an official report of the Government of Iran. The water problem was also discussed in detail by the Commissioners with H. E. Khoxeime Alam, Deputy to the Majlis,

and his technical associates during the stay of the Commission in Seistan. Further discussions were held by the Commission at Tehran with the Minister of Agriculture, H. E. Ebrahim Mahdavi, Mr. Tashakkori, Mr. Behnia (Managing Director, Independent Irrigation Administration), members of the Board of the Administration, and other interested officials. It was noted with interest that Iran has established an Iranian Permanent Hirmand Commission to deal with the problem.

16. During 1950 the Government of Afghanistan also furnished data pertaining to the river to the Engineer-Factfinder for the scientific studies of the Helmand River Delta Commission. In October and November 1950 the value of the McMahon Reports was emphasized to the members of the Helmand River Delta Commission during their work in Afghanistan. The entire problem of the river and its development was discussed by the Commission with H. E. Mohammad Akram Khan, Acting Minister of Public Works, and H. E. Amir-Uddin Khan, President of Agriculture, at Kabul, and with H. E. Abdul Madjid Khan and H. E. Najib-Ullah Khan during the field investigations of the Commission. Through the courtesy of the officials of the Afghan Government arrangements were made for discussions by the Commission with the engineers of Morrison-Knudsen Afghanistan, Inc., at Kandahar, who have been gathering basic data pertaining to the Helmand River for the Government of Afghanistan.

During the Commission's activities in 1950 in Chakhansur, Mr. Madjid presented a paper dealing with water problems of Chakhansur (Appendix IV).

CHAPTER IV

The Helmand River Basin

General Description

17. The Helmand River and its principal tributaries originate in the mountains of central Afghanistan about 50 miles west of Kabul and drain a contributing area of approximately 50,000 square miles. (Reference map—Plate I.) The river flows in a general southwesterly direction through mountainous terrain until it reaches the plains near Girishk. Below this point it enters a trough between two extensive deserts and flows in a wide sweeping arc across southwest Afghanistan to Band-i-Kamal Khan, at which point it turns northward. Downstream, some 40 miles to the north at Kohak (Band-i-Seistan), the river divides into two principal channels through which it flows north and northwesterly to empty into a series of lakes (*hamuns*). The easterly distributary at Kohak, known as the Common River in Afghanistan and as Rud-i-Pariun in Iran, forms the boundary between the two countries for about 12 miles and then divides, flowing to lakes in Afghanistan and Iran. The other distributary at Kohak is the Rud-i-Seistan which flows westerly and north-

westerly to the lakes in Iran. From these lakes the flood waters of the river in exceptionally wet years flow southward and thence southeasterly into a large depression known as Gaud-i-Zireh.

18. Several lesser streams flow into the lakes from the northeast, north, and west, combining with flood waters from the Helmand River to cause these lakes to merge infrequently in times of high water. Chief among these are the Khash-Rud, the Farah-Rud, and the Harud-Rud, which rise in Afghanistan, plus the Bandan and Shur which rise in Iran. The Khash-Rud and the Farah-Rud flow in the spring as the result of snow-melt in the mountains, while the remainder are intermittent, flowing only as the result of storm rainfall.

The Upper Helmand River

19. The main stem of the Helmand River rises on the south and westerly slopes of the Kuh-i-Baba Mountains, whose peaks reach an elevation of 16,000 feet or more. This area is known as the Hazarajat. It is the precipitation in these mountains, largely in the form of snow, which furnishes the major runoff of the lower river. The annual precipitation at Kabul averages less than one foot, but it is probable that the annual precipitation, mostly during the winter months, in the high mountains is much greater. This area is now generally barren except for occasional trees along the streams.

20. The principal tributary of the Helmand River is the Arghandab River, which joins the main stream at Kala-Bist. Minor tributaries of the Arghandab River are the Dori (including the Arghastan) and the Tarnak, both of which combine with the Arghandab River near Kandahar. The headwaters of each of these tributaries lie in the mountains from 7,000 to 11,000 feet in elevation, from which they flow generally southwesterly to their confluence with the Helmand River. Although contributing to the flood flows in the Helmand River, the Arghandab River furnishes no water during the months of low flow, since its low flow below Kandahar is annually consumed by irrigation before reaching the Helmand River.

The Trough

21. The Helmand River below Kala-Bist flows generally westward along a meandering course a distance of 225 miles through a wide trough to its delta on the Afghan-Iranian border. This trough, which averages some 3 miles in width, is flanked on each side throughout its length by arid deserts of vast extent. To the southeast is the Registan, to the south is the Gaud-i-Zireh depression, while to the north lies the Dasht-i-Margo. These desert areas contribute no water to the river, since the precipitation which annually approximates only 2 inches is either absorbed or dissipated by evaporation. Agriculture along the river from

Kala-Bist to the Delta is limited to a narrow strip of land on the floor of the trough that can be reached by a gravity supply of water.

The Delta of the Helmand River

22. The Delta with which this report is primarily concerned may be defined as that area receiving the waters of the Helmand River downstream from Band-i-Kamal Khan exclusive of the lakes and the Gaud-i-Zireh depression. Downstream from this point are found old channels, no longer followed by the river except in time of flood. There is evidence to indicate that the river has not always entered the lakes across its present delta, but it has in times past meandered over a much wider area. One of these sub-deltas on the west is known as the Taraku, while a similar sub-delta on the east was centered around Sar-o-Tar.

23. Today the water of the Helmand River flows northward from the head of the Delta at Band-i-Kamal Khan to Kohak, and is thence distributed into the lake areas through the Rud-i-Seistan and the Rud-i-Pariun (or Common River) and its distributaries, the Pariun-Niatak and the Shela-Charkh. In the latter channel flood waters flow eastwardly to the Ashkeen marsh and the Puzak hamun, which also receive flood waters of the Khash Rud. Helmand River waters flowing through Pariun Niatak reach the Sabari hamun, which also receives flood waters of the Farah Rud and Harud Rud. A third lake lying south of

the Sabari is identified today as the Hamun-i-Helmand. This latter lake receives flood flows from the Rud-i-Seistan and flood overflows from the Sabari hamun and, in high flood years, overflows in turn to the south through the Sar-i-Shela channel to the Gaud-i-Zireh depression. The entire lake area of the Delta is characterized by rising and falling water stages so that the respective areas of open water are surrounded in turn by areas of *Naizar* or marsh land. In times of large flood from the contributing rivers, the waters of the three primary lakes extending through the bordering marsh lands practically merge as one large freshwater lake. During drought periods the lakes shrink to small volume and become brackish.

24. The general topography of the Helmand River Delta, the lakes, and the principal river channels are best portrayed on the maps prepared by the McMahon Mission, 1902–1905. Accordingly a reproduction of one of these maps is included herewith (Plate II) as a "Map of Seistan Showing Irrigation Information, Seasons 1903–1905." The basic facts of the Helmand River Delta are indicated by this map, although it is recognized that, during the 45 years which have elapsed since the surveys were made, river channels have shifted, old canals have been abandoned and new canals dug, and the winds have seriously eroded some areas and covered other areas with drifting sands. Adequate up-to-date maps of the delta areas have not been presented to the Helmand River Delta Commission.

Drainage Areas

25. The drainage areas of the Helmand River and its component tributaries and adjoining deserts are shown in Table 1. It is important to note that the productive drainage area of the Helmand River is all above Kala-Bist, since no effective tributaries join the river below this point and the adjoining areas are deserts with little or no precipitation.

TABLE 1

DRAINAGE AREA OF THE HELMAND RIVER AND OTHER TRIBUTARY AREAS OF THE LAKES

Name of the area	*Subarea in square miles*	*Total area in square miles*
Contributing Area		
Upper Helmand River above Kala-Bist	21,600	
Arghandab and tributaries above Kala-Bist	21,470	
Helmand River between Kala-Bist and Band-i-Kamal Khan	6,230	
Helmand River above Band-i-Kamal Khan (subtotal of contributing area)	.....	49,300
The Delta including the lakes	.....	4,460
Noncontributing areas adjoining Helmand River		
Registan	13,380	
Dasht-i-Margo	10,385	
Total area of adjoining deserts	.....	23,765
Other tributaries to the lakes		
Khash Rud	5,700	
Khuspas Rud	1,840	
Farah Rud	11,250	
Harud Rud	11,240	
Western slopes in Iran (Bandan, Shur, etc.)	6,260	
Total area of other tributaries	.....	36,290
Area receiving flood water from the lakes		
Gaud-i-Zirch	.....	11,695

Climate

26. The climate of the Helmand River Basin varies greatly, changing generally from east to west with the drop in elevations.

The headwaters area in the high mountains of central Afghanistan experiences extreme winters, when most of the precipitation occurs as snow. Summers are cool and dry. The delta area, at the lower end of the river, on both sides of the boundary is surrounded by typical deserts which experience mild winters and hot, dry summers. The water supply with which this report is primarily concerned is greatly affected by the climatic factors imposed on the river in transit from its source to its mouth in the lakes adjoining the Delta. It is generally understood that the snow which falls during the winter melts with the heat of spring to provide the runoff. For that reason there are two principal factors which determine the volume of runoff of the Helmand River—the amount of snow which falls and the spring temperature. For example, if the latter did not rise, most of the snow would remain on the mountain. A sudden and sharp change of temperature, even in a year of less than normal precipitation, can bring about a relatively large flood followed by a drought; but on the other hand, smaller rises in temperature even with larger reserves of snow could fail to produce floods. This is a characteristic feature of snow-fed rivers.

27. The climatic factors of greatest importance in this respect are: precipitation, temperature, humidity, wind, and evaporation.

TABLE 2

MEAN MONTHLY PRECIPITATION IN INCHES AT METEOROLOGICAL STATIONS IN THE HELMAND RIVER BASIN AND IN VICINITY

	In the basin		*In vicinity*									
Meteorological station	Seistan, Iran	Kandahar, Afghan.	Meshed, Iran	Zahidan, Iran	Nok Kundi, Pak.	Chaman, Pak.	Quetta, Pak.	Kalat, Pak.	Kabul, Afghan.	Jalalabad, Afghan.	Peshawar, Pak.	Ft. Sandeman, Pak.
Elev. Ft., M.S.L.	1,600	3,290	3,104	4,718	2,229	4,311	5,490	6,616	5,955	1,950	1,164	4,614
Years of Record	32	11	48	14	13	57	72	42	26	9	87	37
Precipitation												
January	0.54	2.56	1.20	0.65	0.59	1.96	2.12	1.56	1.67	1.25	1.45	0.77
February	0.36	1.47	1.30	0.67	0.35	1.75	1.97	1.40	1.97	1.35	1.48	1.14
March	0.53	1.41	2.30	0.30	0.06	1.51	1.83	1.18	2.37	1.17	2.15	1.33
April	0.14	0.46	1.95	0.30	0.22	0.73	0.93	0.57	2.16	1.27	1.75	0.90
May	0.04	0.10	1.30	0.14	0	0.13	0.40	0.20	0.99	0.40	0.73	0.70
June	0	0.00	0.33	0.03	0	0.01	0.16	0.15	0.16	0.04	0.27	0.61
July	0	0.10	0.05	0	0	0.13	0.51	0.73	0.06	0.11	1.30	2.07
August	0	0	0.02	0	0	0.05	0.40	0.43	0.09	0.15	2.12	1.78
September	0	0	0.05	0	0	0.03	0.05	0.09	0.07	0.12	0.77	0.28
October	0.03	0.01	0.33	0.07	0	0.13	0.12	0.09	0.22	0.06	0.23	0.11
November	0.05	0.04	0.57	0.15	0	0.19	0.26	0.16	0.27	0.08	0.38	0.15
December	0.38	0.58	0.50	0.33	0.20	1.30	1.10	0.81	1.22	0.33	0.72	0.52
Annual	2.07	6.73	9.90	2.64	1.42	7.02	9.85	7.37	11.25	6.33	13.35	10.36

TABLE 3

TEMPERATURE AND RELATIVE HUMIDITY AT SEISTAN, IRAN; TEMPERATURE AT KANDAHAR, AFGHANISTAN

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Temperature in degrees Fahrenheit at Seistan													
Mean temperature	46.0	50.6	60.3	71.1	80.4	87.5	90.8	88.2	79.6	69.1	56.7	47.6	69.0
Mean max. temp.[1]	57.8	63.2	73.4	84.1	93.4	100.4	102.8	100.1	92.8	84.1	71.6	60.4	82.0
Mean min. temp.[2]	34.3	38.1	47.2	58.1	67.3	74.6	78.9	76.2	66.3	54.1	41.8	34.8	56.0
Highest temp.	78	89	94	99	109	112	112	113	107	101	87	79	113
Lowest temp.	17	23	28	43	51	61	65	68	52	36	23	18	17
Relative humidity at Seistan—percent													
Relative humidity at 0700 hours	81	73	68	57	49	37	36	35	42	53	62	75	56
Temperature in degrees Fahrenheit at Kandahar, Afghanistan													
Maximum	69	78	89	97	104	110	110	109	104	97	87	76	110
Minimum	19	22	22	35	44	51	56	51	42	29	14	15	14
Monthly Mean	44	51	59	68	76	82	87	82	74	64	53	44	65

[1] Mean of the daily maximum temperatures.
[2] Mean of the daily minimum temperatures.

Wind

30. The significant characteristic of the wind insofar as it affects the Delta is the "120-day wind," extending from the end of May to the end of September each year. During this time the wind blows strongly from the northwest to make life burdensome for both man and beast. The average velocity for the 4 months is about 13 miles per hour, but gusts sometimes reach as high as 70 miles per hour. From data published in the *India Weather Review*, the average variation of the wind by months is as shown in Table 4.

TABLE 4

SEISTAN, IRAN: PREVAILING WIND [1]

Month	Prevailing wind		Month	Prevailing wind	
	Direction	Velocity [2]		Direction	Velocity [2]
January	NW	4.2	July	NW	14.2
February	NW	5.2	August	NW	13.7
March	NW	5.7	September	NW	11.0
April	NW	7.5	October	NW	6.0
May	NW	9.6	November	N	5.2
June	NW	11.7	December	NW	4.0
			Annual	NW	8.3

[1] From published India Meteorological data.
[2] Wind velocity in miles per hour is mean of 4 and 12-hour readings.

Evaporation

31. Due to the combination of the factors of wind, temperature, and humidity the evaporation in the Delta is known to be high. No observations of evaporation have been made in the area within recent years.

Conditions in Seistan, Iran and Chakhansur, Afghanistan

32. The delta area of the Helmand River has been occupied for many centuries. People would settle and build villages in those years when water was plentiful and then were forced to move to new places when faced by drought, the shifting sands of the desert, or changing channels of the river. These fluctuating developments of the past may be traced in such ruins as those of Sar-o-Tar, Ziarat Amiran, and Nad Ali in Chakhansur, Afghanistan, and Rustam and Machi in the Hauzdar area of Seistan, Iran, and Old Zahidan near Zabol, Iran.

33. The cultivated lands of Seistan and Chakhansur are irrigated by uncontrolled canals leading from the principal river channels. The maintenance of these canals is a hard struggle for the people, since during the low-water period of the summer the "wind of 120 days" often obliterates long sections of these canals.

34. Large areas of Seistan and Chakhansur are subject to flood damage from the water of the Helmand River, as the water spreads over the land through the uncontrolled canals. Other large areas are inundated in those years when the lake levels rise, causing the villagers living on the edge of the reed marshes to move to higher ground.

35. That part of the Helmand River Delta, ancient and modern, in Iran is the Seistan subprovince of which the principal

town—Zabol—has an estimated population of 15,000. Although no census has been taken in the area, the government officials of Iran estimate that the total population of Seistan is greater today than at the beginning of the century. The people dwell in small villages and cultivate the land or dwell near the lakes and live by hunting, fishing, and stock raising.

36. The Chakhansur subprovince of Afghanistan includes not only lands along the Helmand River downstream from Rudbar but also lands served by waters of other streams flowing into the lakes which adjoin the Delta of the Helmand. In this present report Chakhansur is used to describe those lands in the Chakhansur subprovince in the Helmand River Delta below Band-i-Kamal Khan. The people of the area live in small villages of which the largest is Kala-i-Kang. The total population of Chakhansur has probably not varied greatly during the last half century.

CHAPTER V

Agriculture in the Delta

Method of Cultivation and Harvesting

37. The crops and the manner of their cultivation in the Delta of the Helmand River are at present precisely as they have been in the past, probably for hundreds of years. Today practically all of the plowing and cultivating is done by oxen pulling wooden plows, or by the farmer with a hand implement which is a combination hoe and shovel known as the *tisheh*. The sowing is still done by hand, the resulting density of the crop depending entirely upon the skill of the sower. Harvesting of the grain is accomplished by scythes. The threshing is done by driving cattle over the harvested grain, and the grain is separated from the straw by tossing into the air.

Crops

38. In this typical desert area where the rainfall is very slight, the production of any crop is entirely dependent upon irrigation. The cultivation of summer crops in the Delta is precluded to a large extent by the fact that the Helmand River is always at a low stage in July, August, and September (dry on rare occasions)

and by the winds of this area. The winds which prevail almost continuously from May or June into September are such a distinctive feature of this area that they are known as the "winds of 120 days." With the principal irrigation thus limited to the winter months, during which period the wind creates no special problem, the crops are similarly limited to those which can be produced in that season. These have been found by experience to be wheat and barley which comprise practically the entire acreage that is annually irrigated. Other crops besides wheat and barley which have been planted as winter crops are so small in acreage and so infrequently planted that they may be considered as negligible.

39. In spite of the strong prevailing winds during the summer months, a limited acreage is annually planted to crops which will grow only in the summer season. Those which have been mentioned to the Commission are melons, beans, corn, cotton, garden vegetables and orchards. The total acreage in such crops in Seistan at the time of the McMahon investigations was found to be about one-seventh of the acreage of the winter wheat and barley crops. The estimates of present-day crop acreages presented by the agriculture officials of Iran in the report entitled "Irrigation Water Required Annually in Seistan" indicate that the same relation between summer and winter acreage still prevails. It is probable that the same relation also holds today

for Chakhansur, although at the time of the McMahon Mission it was found that the acreage in summer crops was about one-third of the acreage in winter crops. Since the planting of the summer crops and the first irrigations of these crops coincide with the time of greatest flow in the Helmand River, there has been heretofore no special problem in connection with the supply of water for the first irrigation of these crops. However in spite of the small acreages planted, it appears that often a portion of the summer crop fails due to lack of water as the stage of the river falls.

40. The acreage planted to each crop in both winter and summer was determined from field studies made during the investigations of the McMahon Mission. Details concerning these acreages may be found in chapter VIII on "Water Requirements for Irrigation." Since the close of those investigations in 1905 there has been no further survey which would furnish such details, and only estimates of acreage made by the government officials in Iran are available. No estimated breakdown of the acreage irrigated in recent times in Afghanistan was furnished the Commission. Following the usual custom in irrigation throughout the whole delta area, only about one-third of the land served by the canals is planted each year, the remainder being allowed to lie fallow. This practice has developed through the years, as it was found to be necessary to retain the fertility of the soil. No com-

mercial fertilizer is applied. Practically all stubble is used for fuel, leaving nothing for protection of the soil against the wind and returning nothing to the soil.

41. Wheat and barley, which comprise the staple food of the inhabitants, are planted in the fall starting about the end of September. As the flow of the river increases with the advance of the fall season, the entire winter acreage is planted. It frequently happens that the planting season extends through January. Because there is practically no rain during the summer and the continuous winds have dried out the soil, it is the custom to irrigate the land once before planting. After the seed has been sown and the crop starts to grow, three to five applications of water are required to mature the crop which is harvested ordinarily in late April and May. Water is applied to the crop by flooding the fields. The customary depth of water supplied in each application is about ten centimeters or four inches, as indicated by the farm people in both Seistan and Chakhansur. This figure is also indicated as the proper depth of application by the Ministry of Agriculture officials in both countries. The summer crops are irrigated in a similar manner, the preplanting irrigation and the planting taking place usually in April or May. These crops are harvested by early autumn.

Canals

42. The cultivated lands of Seistan and Chakhansur are irrigated by uncontrolled canals leading from the principal river channels. All canals have been dug by hand, with little design or planning employed in laying them out. The result is a series of canals more or less parallel, and frequently two or more canals lie close together. As a general rule the canals meander, making their length much greater than is necessary to serve the same lands. These crooked alignments are often the result of the abandonment of portions of the canal and the construction of a new section as required by shifting sands. In cross section these canals are usually quite deep and narrow. The soil is of such a nature that it stands well along the canal banks where it is kept moist. However there is some slumping of the bank materials above the water line into the canals, thus making maintenance a heavy burden.

43. The maintenance of the canals is a hard struggle for the people, since during the low-water period of the summer the "wind of 120 days" often obliterates long sections of these canals. This condition explains the many cases where old canals have been abandoned and new canals dug to serve the same areas. In the fall when the "wind of 120 days" stops blowing, the canals are laboriously cleared by hand of the wind-blown deposits and often brush dams and spur dikes of brush are built to divert some of

the low-river flow into the canals. These brush dams and spur dikes, however, are damaged or washed out by the first rise in the river. The Commission observed this condition in Seistan in November 1950, when the major part of the low flow of the Helmand River was escaping through broken brush dams into the Rud-i-Seistan and flowing unused to the lakes. Obviously, even at ordinary minimum discharge, much of the daily flow of the river passes unused through the Delta to the lakes.

44. It is interesting to note that there seems to be a pronounced deterioration in the canal system since the early days as evidenced by the following description of the ancient canals:[1]

> *Ancient Canals:* Little need be said about these canals; we ran a line of levels along the Zorkan and Zarkan Canals from their heads in the present river valley, 4 or 5 miles to the north of Kala-i-Gáwak to their tails in the delta of the Khásh. We found these canals quite the most skilfully constructed in the delta. They have long lengths of straight on them, and were evidently set out with thought; the curves are nominal, and it is evident they were not considered necessary. . . .

45. A contrast between these ancient canals and some of those in operation at the time of the McMahon investigation in 1902–1905 may be gained from his description of those then in operation as follows:[2]

> Each village has its own canal where possible, but villages lying far away from the river unite to have a main channel of supply, but even so there are a very large number of parallel canals, as will be evident from a glance at the map of the Rud-i-Seistán towards

[1] *Seistan Irrigation Report*, vol. 1, p. 28.
[2] *Ibid.*, p. 27.

> the tail of the Rud-i-Hasanki near Zahidán and Iskil . . . and north of Kala-i-Fath there are an immense number of parallel channels for the irrigation of the Palangi tract. . . .
>
> Purely artificial canals are also cut; they are usually very simple works with no great depth of excavation or other difficulties to contend with. The channels twist and turn, much as the zamindari canals to be seen on old canals in the Punjab before the light and leading got from the Chenab Canal shewed that it was possible for a cultivator to make as straight a ditch as an engineer.

46. Apparently this deterioration in the canal system is still going on due to the continued lowering of the river channels and the increasing difficulty of getting water into the canals. Those canals which were noted by the Commission certainly indicated no evidence of improvement.

47. It is evident from a study of the maps of the McMahon Mission that many changes in canal locations have occurred during the past 50 years. A chart presented by the Iranian Government officials indicates the following principal present-day canals in Seistan, each of which is subdivided into numerous branches: from Kohak downstream along the Rud-i-Seistan—Nahr Khadjeh Ahmad, Nahr Azar, Nahr Nimak, Shah Nahr Hassanki, Nahr Malik Heidari, Shah Nahr Zohak, Shah Nahr Tahiri, and Shib Abad River; from the Rud-i-Pariun downstream from Kohak—the Canal Milak, Golmir, Nahr Lakhshak, and small canals diverting directly from the Rud-i-Niatak. In Chakhansur, diversion canals from the Helmand River and thence the Common River progressively downstream from Band-i-Kamal Khan are the Daki-Dela on the left bank and the Khawbga Canal, Nahr-i-

Shahi, Maringi Canals (three), the Shela Charkh, and the Nahr-i-Ibrahim on the right bank. It is extremely difficult to assign water capacities to these canals because of irregular cross sections, and also because the rate of diversion into each canal varies not only with the stage of the river but with the conditions of such brush dikes or dams as may have been built in the river channel below the head of the canal.

Waste of Water

48. Generally speaking, the practice of irrigation followed throughout the Delta is wasteful of water. This fact was recorded in the 1950 Iranian report "Water Required Annually in Seistan" as follows:

> Suffice it to say that in Iran even such a meagre supply of water which is available for irrigation purposes is squandered recklessly, the amount of water ultimately spread on the land being only a small fraction of the original.

The wastes noticed by the Commission while traveling through the Delta are most frequently the kind that result from carelessness or inefficiency in irrigating and are not to be confused with the so-called unavoidable wastes which are always incident to the handling of water on any irrigation project. Any curtailment in the useless waste of water would not only improve the quality of the soil through a reduction in the salt encroachment but would provide that much more water for an expansion in acreage.

Soils

49. The soils in the delta area have developed on alluvial deposits laid down by the river throughout the years, mostly from limestone and other sedimentary rocks. In texture there is quite a range in size, from fine clays to stone or gravel, although the fines greatly predominate. Mixed with these soils there are considerable areas with wind-shifted surface layers of fine and medium sand.

50. As the Delta, which comprises this entire area, has been built up through the ages by the silt carried in by the river in each successive flood, the soil has been laid down to unknown depths. The soil is fertile and contains large amounts of the more soluble compounds of sodium and other elements characteristic of the typical desert. However, due to the denuded or barren condition of the entire watershed from which this silt is derived, the content of organic matter in the soil is very low. The concentration of salts is very evident in some parts of the Delta and has caused the abandonment of large tracts that were formerly irrigated.

51. These soils of fine-textured water-laid materials are relatively impervious with a fair moisture-holding capacity. While these characteristics of the soils have been an advantage to irrigation, these same characteristics are a disadvantage in the matter of drainage. Poor circulation in the subsoil and inadequate

drainage have caused the salts to rise to the ground surface. In many areas, particularly in Seistan, these salts have been scraped up and piled in the middle of the field. Mounds of the salty earth four and five feet high were observed at frequent intervals in these areas. While no similar mounds were noted in Chakhansur, it is quite possible that the same conditions may prevail on that side of the Delta. When the salt problem becomes too great to be handled by this scraping method, the fields are abandoned.

Soil Cover

52. Another serious problem of the Delta has been aggravated in the past 50 years by the harvesting of the tamarisk thickets which were formerly quite extensive. These thickets which constitute about the only source of fuel supply in the area have been cut, leaving the soil completely denuded. No replacement has been attempted. The result is that large areas of barren soil have been thus exposed to the wind and are now seriously eroded.

53. The following references give some indication of the extent to which tamarisk grew in the Delta at the time of the McMahon Report:[1]

Re the journey of Colonel Yate, 1894

The next branch was met after going for seven miles through dense tamarisk with small clearings for cultivation here and there.

[1] *Seistan Revenue Report*, vol. I, pp. 319, 320, 323 n.

The road to Pulgi then crossed 8 miles of flooded lands covered with dense tamarisk.

Re the Nad-i-Ali channel

From the banks at places not obstructed by tamarisk the eye overlooks the country for a great distance just as it does from an artificial canal bank.

54. With the tamarisk now seriously depleted, as the Commission was so many times reminded while in the field, it is probable that the areas which were formerly covered with tamarisk, but which are now more or less denuded, may account for the fact that the sands are on the move to a greater extent in the Delta than in the past.

55. This depletion of the tamarisk is still vigorously persisting, as indicated by one of the engineers for Iran, who gave the following requirements for tamarisk in Zabol for use as fuel:

The power plant—using 7 to 10 tons of tamarisk per day.
5 brick kilns each using 400 donkey loads of tamarisk per day.
4 lime kilns each using 200 donkey loads of tamarisk per day.
These uses are so depleting the tamarisk that it is necessary to bring it in from as far away as 30 kilometers by donkey or camel.

56. In its travels through Chakhansur and Seistan the Commission did not note any control of the grazing of the flocks of sheep and goats. Such close cropping of the grasses results in extensive erosion by the wind in the summer. It is possible that, through experiment, drought resistant grasses such as a "thatching" grass which have proved of value as ground cover in similar desert regions in other parts of the world could be adapted successfully to both Seistan and Chakhansur. A good grass cover

would afford protection from erosion by the wind without requiring the large volume of water necessary for control of erosion through other means.

Stock Grazing in the Reed Marshes

57. The extensive areas of marshes which border the lakes in Seistan serve as the grazing grounds of many Seistani cattle. The people who raise these cattle live in small villages adjoining the edge of the marshes and supplement the living earned by the sale of dairy products from the cattle by hunting and fishing in the waters of the lakes.

CHAPTER VI

Irrigated Acreage in the Delta

58. For purposes of this discussion the Delta can be defined as the area in the Helmand River Basin downstream from Band-i-Kamal Khan.

Ancient Cultivation

59. Evidence of former irrigation shows that a wide region on both sides of the present river has at some time in the past been irrigated. By its meandering all over the Delta the river has made possible at various times the irrigation of lands quite distant from its present location. The magnitude of the development that existed in these far-flung areas is indicated by the remains of former cities and fortresses, many of which were destroyed or abandoned many centuries ago. History of this area tells of the location of the river at various times and of the cities and civilizations that had to be abandoned when the river changed its course.

60. Since the course of the river across the Delta has been changing throughout history, the centers of population and the consequent irrigation developments upon which they were de-

pendent have also been subject to change. The Commission saw evidences of these ancient civilizations on both sides of the Delta, in Seistan and Chakhansur. That all of these former centers of population were not in existence simultaneously is clearly apparent. It is probable that with the river changing its position on the Delta at relatively frequent intervals in the past, even as it is doing today (sometimes through the aid of man), the acreage actually irrigated at any one time was not any greater than that under irrigation today. Also as the river changed its course from one side of its delta to the other, it is quite likely that a large part of the acreage irrigated was at one time wholly in the area now called Afghanistan, while at another time the entire area irrigated may have been within the limits of Iran as now constituted. Prior to 1872 when the boundary was defined by the Goldsmid Award, there was no international question involved as the river changed its course. Since 1872 the river has been essentially in the position it now holds.

Period of 1902–1905

61. During the investigation in the field by the McMahon Mission, 1902–1905, a careful analysis of the acreage under irrigation in both countries was made. Under title of "System of Agriculture and Agricultural Products of Persian Seistan," the McMahon Reports read as follows on the acreage irrigated in Iran: [1]

[1] *Seistan Revenue Report*, vol. I, p. 55.

Persian Seistan comprises an area of about 500,000 acres of culturable land irrigable by the existing canal systems. Of this area about 150,000 acres are annually cultivated. Statements A and B give a careful record of the cultivation done in 1903–04. The total figures at line 131 of statement B illustrate the proportions of spring and autumn cultivation as follows:

Name of crop		*Area in acres*	*Total area in acres*
Spring crops [1]	wheat	93,255	....
	barley	35,197	....
	opium	145	128,597
Autumn crops [2] of all kinds		20,352	20,352
	Grand total	.....	148,949

[1] McMahon's designation of the spring crop means that crop which is harvested in the spring, the same being called in this report the winter crop.
[2] McMahon's designation of the autumn crop means that crop which is harvested in the autumn, the same being called in this report the summer crop.

The autumn or Kharif cultivation is thus less than one-seventh of the whole cultivation of the year.

62. In Chakhansur during the period 1902–1905 the McMahon Mission found there was an area of about 145,200 acres that could be served in irrigation by the existing canals. The acreage irrigated annually during that time, however, was only a fraction of the 145,200 acres. According to the McMahon Reports, the acreage irrigated was as follows:

From Band-i-Kamal Khan to Band-i-Seistan [1] (Kohak)
- Winter crop, 10,000 acres
- Summer crop, 4,300 acres

Below Band-i-Seistan [2]
- Winter crop, 19,506 acres
- Summer crop, 7,192 acres

[1] *Seistan Revenue Report*, vol. III, p. 164.
[2] *Seistan Irrigation Report*, vol. II, p. 112.

63. The total area then irrigated from the waters of the Helmand River in Chakhansur was as follows:

Winter crop,	29,506 acres
Summer crop,	11,492 acres
Total,	40,998 acres

Period of 1936–1942

64. A chart showing the acreage served by each canal in Seistan was given to the Commission while it was in Iran in 1950. This chart was presented by the representatives of the Independent Irrigation Administration as reflecting the conditions during the period from 1936 to 1942.

65. The summary of acreage depicted by this chart indicates a total of 465,380 acres that may be reached by the existing canals. Included within this area are the lands along the Pariun-Niatak northward from the Common River to the lakes, which have been abandoned with changing river conditions and movement of sand dunes. This area covered by sand dunes was noted when the Commission flew over Seistan. The approximate outline of this and other abandoned areas on the map of Seistan includes a total area in excess of 100,000 acres. Thus the acreage now served by the canals is probably not more than 365,000 acres.

66. It has been indicated by the officials of the Independent Irrigation Administration that not more than one-half of this acreage was ever irrigated at any one time, and that occurred only in the best water years. On the basis of one-half, the maximum acreage ever irrigated within the period 1936–1942 may be taken as 182,500 acres. Irrigation as commonly practiced in Seistan, as indicated by the village representatives before the

Commission in Zabol, involves only about one-third of the available land each year. Accordingly it is probable that only about one-third of the acreage on the average was irrigated annually. Such a figure would be about 122,000 acres as an average for the period 1936–1942.

67. It is possible that this figure of 122,000 acres represents the winter irrigation and an additional acreage was involved in the production of summer crops. If these summer crops were in the same proportion to the winter acreage as was found during the time of the McMahon Mission and also as shown in the 1950 report "Irrigation Water Required Annually in Seistan," it is thus indicated that about 18,000 acres were devoted to summer crops as an average for the period. The sum of these figures shows a total irrigated acreage in Seistan of approximately 140,000 acres. The period 1936–1942 includes at least one severe drought year (1936) and one year of heavy flood (1939), so the average should be quite representative.

Period 1950

68. The report of the Independent Irrigation Administration of Iran, "Irrigation Water Required Annually in Seistan," indicates that the irrigated acreage varies somewhat with the water supply, with averages given for the various crops according to

whether the year is dry or wet. The figures submitted in the Iranian report are as follows:

	Average	
	Dry years	*Rainfall years*
Winter crop	138,300	190,000
Summer crop	19,500	27,000
	157,800	217,000

69. The cultivable area of Iranian Seistan is divided for purposes of jurisdiction into six districts. At a public hearing held by the Commission in Zabol, representatives of these districts submitted figures on the acreage served by their canals and also on the areas actually irrigated under present conditions.

70. The districts and their approximate acreage of cultivable land are as follows:

District	*Total area in shares*
Miankangi	9,000 shares
Posht-Ab	11,000 shares
Posht-Rud	not given
Shib-Ab	9,000 shares
Shahreki and Naroui	8,400 shares

71. With the area in the Posht-Rud estimated as possibly 2,500 shares,[1] there is a total area within the limits of Seistan of 39,900 shares. Each share contains an area of 3.6 hectares, or the equivalent of 8.89 acres. The total area thus involved is therefore 352,500 acres. This figure compares with 365,000 acres as indicated by the chart of the canals of Seistan in the period 1936–1942.

[1] From an analysis of the acreage chart showing area served by each canal in Seistan, as furnished by the Independent Irrigation Administration.

72. The area in each subdivision that was indicated by the representatives to be actually irrigated on an average is given below:

District	*Area irrigated*
Miankangi	3,000 shares
Posht-Ab	4,400 shares
Posht-Rud	none
Shib-Ab	4,500 shares
Shahreki and Naroui	2,800 shares
	14,700 shares

73. This is equivalent to approximately 130,700 acres, which is probably the total area of the winter crops. The representatives further indicated that the village gardens were not included in the above figures. It is estimated herein that the gardens may involve an area of 10,000 acres. Other summer crops would possibly include as much additional acreage, making the area in summer crops equal to 20,000 acres. The total area of winter and summer crops is thus indicated to be 150,700 acres.

74. From the observations of the Engineer-Factfinder while in the field, it was estimated that the area irrigated in Chakhansur in 1950 was:

Winter crops	28,000 acres
Summer crops	8,000 acres
	36,000 acres

75. The village representatives of Chakhansur in meeting with the Commissioners at Khawbga did not give the acreage under irrigation in each subdivision therein, but did indicate that within the last few years as many as 6,000 families have left

Chakhansur, thus abandoning a considerable acreage that was formerly irrigated. It is the belief of the Commission that the acreage in Chakhansur actually irrigated from the waters of the Helmand River in recent years has not exceeded 36,000 acres, which would include both winter and summer crops. This acreage is only a small fraction of the area of cultivable land in Chakhansur, which was estimated by the McMahon Mission to be as large as the area susceptible of irrigation in Seistan.

Summary of Irrigated Acreage

76. The acreage formerly irrigated and now irrigated, as determined from the best information available, is summarized in Table 5. No information was furnished to the Commission for any periods other than those shown in this table.

TABLE 5

AREAS IRRIGATED BELOW BAND-I-KAMAL KHAN IN ACRES

Seistan, Iran

1902–05: McMahon		
Winter crop	128,597	
Summer crop	20,352	
	148,949	
1938–42: Data given to Commission while in Iran	on basis of (½)	(⅓)
Winter crop	122,000	182,500
Summer crop	18,000	
	140,000	
1950: Official Iranian Report	Average dry	Average rainfall
Winter crop	138,300	190,000
Summer crop	19,500	27,000
	157,800	217,000

TABLE 5—Continued

1950: Data presented at public hearing at Zabol	
Winter crop	130,700
Summer crop	20,000
	150,700
Chakhansur, Afghanistan	
1903–05: McMahon	
Winter crop	29,506
Summer crop	11,492
	40,998
1950: Estimated	
Winter crop	28,000
Summer crop	8,000
	36,000

77. Attention is particularly called to the fact that the only available information on irrigated acreage for Seistan and Chakhansur that is based on actual field surveys is that recorded by the McMahon Mission, extending over 3 years nearly 50 years ago. This Commission had no opportunity to make a similar investigation, nor was it thought necessary by the two Governments concerned that such an investigation be made at this time. Instead the analysis of acreage irrigated as shown in the above tabulation has been based on the figures submitted by the irrigators themselves or the official representatives of the Government in each country. This information has been weighed by the Commission, and the conclusion is drawn that since the time of the McMahon Report there has been little change on the average in the total areas irrigated in the Delta.

Traditional Acreage Irrigated in Seistan and Chakhansur

78. In the minutes of the meetings held in Washington, D.C., by representatives of Afghanistan and Iran from August 9 to

September 7, 1950, regarding the Helmand River Delta Commission, the term "traditional" was defined as follows:

> I should like to make further clarification with regard to the word "traditional." By that we mean the irrigation practices, the types of crops, extent of land, availability of water supply in the river during the various cycles of dry and wet in the past 80 years, the origin of time being the year 1872 . . .

79. Since there are no data available on which to define conditions of irrigation in the delta of the Helmand River in 1872, it is considered that the traditional acreage annually irrigated from the waters of the Helmand River in Seistan and Chakhansur is the average that was irrigated during the time of the investigations by the McMahon Mission. As noted above the Commission has concluded that since the time of the McMahon Report there has been little change on the average in the total areas irrigated, either in Seistan or in Chakhansur. Therefore the traditional irrigated acreage may be considered to total 190,000 acres, distributed as follows:

In Seistan, Iran	149,000 acres
In Chakhansur, Afghanistan	41,000 acres
	190,000 acres

It is recognized that in some years irrigation in either Chakhansur or Seistan may have encompassed a larger acreage, while in other years undoubtedly a lesser acreage has been irrigated.

Present Day Acreage Irrigated in the Delta

80. It also appears to the Commission that the acreage irrigated in Chakhansur within the past few years has declined.

This apparently is the result of the drought in 1947 and the difficulties encountered in getting the water into the canals since then. At the same time there has possibly been a slight increase in the acreage irrigated in Seistan.

81. From the figures that were presented to the Commission, and estimates that had of necessity to be made by the Commission, it is concluded that the irrigated areas representative of present conditions in the Delta are as follows:

In Seistan, Iran	154,000 acres
In Chakhansur, Afghanistan	36,000 acres
	190,000 acres

CHAPTER VII

Water Supply of the Helmand River Delta

Hydrologic Data—Past and Present

82. The systematic collection of stream-flow data has recently been undertaken by the Governments of both Afghanistan and Iran as an initial step in the evaluation of their water resources. However, hydrometric (stream-flow) data are quite limited in the Helmand River Delta and due to this fact the hydraulic studies which are presented in this report will probably require revision as the period of record is extended through future years.

83. Present day stream-flow records in the delta area include those of the gaging station maintained by the Afghan Government on the Helmand River at Chaharburjak just upstream from the head of the Delta at Band-i-Kamal Khan, well above the effect of backwater from temporary diversion dams, and of two gaging stations maintained for brief periods by the Iranian Government in the Seistan area. These gages were one on the Rud-i-Seistan and one on the Rud-i-Pariun (Common River). Accurate stream gaging is difficult in the Seistan area due to frequent changes in river conditions caused by shifting channels and the periodic

construction of temporary brush dams for diverting the low flow into canals. The only other discharge record in the delta area is that at Kohak, maintained on the Helmand River by the McMahon Mission 1902–1905.

Gaging Station on the Helmand River at Chaharburjak, Afghanistan

84. The gaging station maintained by the Government of Afghanistan on the Helmand River at Chaharburjak just above the head of the Delta has been in operation since October 1948. The station consists of a continuous water-stage recorder (suitably housed) and a cableway for discharge measurements. The Chaharburjak station is approximately 10 miles upstream from Band-i-Kamal Khan, which latter place has previously been considered as a place for the measurement of Helmand River flows reaching the Delta. This station is well above the effect of backwater from temporary diversion dams. The control has been reasonably stable during the 2 years it has been in operation and hence the records are considered reliable. It would be advisable to consider this Chaharburjak station as one of the key Afghan gaging stations on the river where a long-term record will be secured.

85. A comparison has been made of the records for the Chaharburjak gaging station and records of observed flows on the upper Helmand and Arghandab Rivers, made available by

the Government of Afghanistan for the scientific studies of this Commission. On the basis of the recorded flows at these upriver gaging stations, the mean monthly flows and monthly discharge have been computed for the Helmand River at Chaharburjak for the period October 1946 through September 1948. Thus an estimate of runoff for 4 recent water years is available for the Helmand River at Chaharburjak. These data are in Table 6. They are indicative of flows at or below Band-i-Kamal Khan in Chakhansur, Afghanistan. In using these data allowances must be made for water diverted into canals between Chaharburjak and Band-i-Kamal Khan and for evaporation and seepage losses in the river channel. In referring these data to Kohak, adjustments must be made for the additional diversions and channel losses between Band-i-Kamal Khan and Kohak.

Gaging Station on the Rud-i-Seistan, Iran

86. Some stream-flow records have been obtained by the Government of Iran in recent years on the Rud-i-Seistan, a distributary of the Helmand River. These records are for the following periods:

Gaging station	*Period of record*
Rud-i-Seistan below Kohak	April 1942–May 1943, inclusive November 1947–May 1950, inclusive

87. The information furnished to the Commission for the station on the Rud-i-Seistan below Kohak for the period April 1942–May 1943, inclusive, was a tabulation of the daily dis-

charges. Neither a rating curve nor a description of this gaging station were made available.

88. The station maintained on the Rud-i-Seistan from November 1947 to May 1950 was located immediately downstream from the bifurcation of the Helmand River at Kohak and consisted of a staff gage which was read once or twice a day. The discharge rating curve for this station was developed from 20 meter observations taken during the period of record with a wading rod or, as the river stage increased, from a small reed boat.

89. The Commission has reviewed the records for the Rud-i-Seistan and has decided that little reliance can be placed on the data, because of the fact that brush dams are built from time to time in the river channel immediately downstream from this location, thereby frequently changing the gage height-discharge relation at the station. No consideration appears to have been given to this fact in the preparation of runoff records.

90. With the initiation of construction operations in the Rud-i-Seistan in the summer of 1950, the gaging station just downstream from Kohak was abandoned. The only stream-flow information presented to the Commission for the period from May to November 1950 was a hydrograph based apparently on daily discharges for only 9 days between May 28 and October 1. These data are much too limited to serve as an accurate index

of the actual flow conditions in this particular period. Therefore no use has been made of them.

Gaging Station on the Rud-i-Pariun

91. The Government of Iran made available certain stream-flow records for the Rud-i-Pariun below Kohak for the period April 1942–May 1943, inclusive. However, detailed information was not supplied regarding the location of this station although it was understood to be on the Rud-i-Pariun (also known as Common River) some distance below Kohak. The hydrometric data for this station could not be applied without knowledge of the location and some record of discharge measurements.

Discharge Data 1902–1905

92. The McMahon Mission of 1902–1905 initiated gaging of the Helmand River above Kohak in February 1903 and concluded its observations in May 1905. Discharge measurements were made by the float method. Discharge measurements made with velocity rods in October and November 1904 led to the conclusion that the basis of calculation was reasonably accurate. Although the actual period of discharge observations was limited to a period of 27 months (February 1903 to May 1905), the record was carried back to the beginning of October 1902 from details collected in the field. From subsequent measurements the discharge record was extended to the end of September 1905. Thus a record for

three water years—three spring and three autumn crop seasons—was made available. These data are included in Table 7.

Historical Information on Runoff for Period 1927–1950

93. Supplementing the recorded flow data certain information has been obtained from official sources and by questioning residents of Seistan, Iran and Chakhansur, Afghanistan in regard to the floods and droughts of this region. The following analysis of Helmand River Delta conditions in recent years is compiled from this information and is presented in the descending order of probable accuracy, from 1950 back to 1927. The terms "above normal," "normal," and "below normal" are not based on scientific data, but on "impressions." These general characterizations of the years from 1936 to 1949 were furnished by the Independent Irrigation Administration, Tehran.

1950 (1329[1])—Above normal

1949 (1328) —Above normal

1948 (1327) —Normal

1947 (1326) —Very dry year. The lakes dried up during the summer (reported by the local people and by official sources). On July 25 just above Kohak the discharge of the Helmand River was 47 c.f.s.; the Nahr-i-Shahi, the Nahr-i-Khawbga, and the Maringi Canals were dry and there was no flow in the Common River. On July 28 the Chaharburjak Canal was dry and the flow of the Helmand River at this point was only 60 c.f.s. On the same day there was no flow in Nahr-i-Bandar (20 miles upstream from Chaharburjak) and only 3 c.f.s. in Kala-i-Fath Canal at its diversion point. On August 11 the flow of the Helmand River at Band-i-Kamal Khan was only 5 c.f.s. and

[1] Equivalent Iranian year beginning on Mar. 21, 1950.

on August 12 both the Kala-i-Fath and Daki Dela Canals were found dry. The canals of Chakhansur and Seistan were dry during August. On August 23 the flow of the Helmand River at Shamalan village was only 58.5 c.f.s. (From official Afghan records).

1946 (1325) —Dry year

1945 (1324) —Below normal

1944 (1323) —Below normal

1943 (1322) —Good year. More than normal but no major flood.

1942 (1321) —Flood year

1941 (1320) —Normal year

1940 (1319) —Wet year

1939 (1318) —Critical flood year. The flow corresponding to the maximum high water at Chaharburjak is estimated as 145,000 c.f.s. This estimate is based on a high-water mark located in 1950 and referred to the Chaharburjak discharge station. It should be checked by other high-water marks. Local residents in Seistan and Chakhansur report that the lakes were full. Waters of Hamun-i-Puzak and Hamun-i-Sabari merged north of Salian. The flood started about the first of February and lasted 80 or 90 days. Large areas in the Delta, normally cultivated, were under water.

1938 (1317) —Normal

1937 (1316) —Below normal. On October 6, 7, and 8 a joint Afghan-Iranian party measured the flow of the Helmand River at Band-i-Kamal Khan as 1,200 c.f.s. (Public Works Ministry, Kabul) On October 15 the flow of the lower Helmand River at Band-i-Kamal Khan was 1,180 c.f.s. (33.42 c.m.s.)

1936 (1315) —Dry year. The flow of the Helmand River at Band-i-Kamal Khan was measured by a joint Afghan-Iranian party as follows: On September 4, 415 c.f.s. (11,775 liters); on September 19, 267 c.f.s. (7,573 liters); and on October 8, 420 c.f.s. (11,860 liters). (Irrigation Department, Tehran) On October 16, the flow of the Helmand River at Band-i-Kamal Khan was measured as 550 c.f.s. (Afghan records)

1935–1933 (1314–1312)—Ample supply in the lower Helmand. In February 1935 the flow at Band-i-Kamal Khan was measured as 2,120 c.f.s. (60 c.m.s.) (Irrigation Department, Tehran)

1932–1931 (1311–1310)—Joint Afghan-Iranian teams met to divide the flow of the Helmand at Band-i-Kamal Khan but there was plenty of water and no measurement was made.

1931 (1310) —The Sar-i-Shela, the overflow of the lakes, flowed in May. Abnormal floods in January did extensive damage to the crops in Seistan. (Recorded at British Consulate, Zabol)

1930 (1309) —Extensive floods occurred in late March and April in Seistan. (Recorded at British Consulate, Zabol)

1929 (1308) —Floods occurred in Seistan in March and December. (Recorded at British Consulate, Zabol)

1927 (1306) —An acute shortage of water occurred in Seistan in August due to the low stage of the Helmand River. (Recorded at British Consulate, Zabol)

Historical Information on Runoff for Period 1838–1905 from the Report of the McMahon Mission, 1902–1905

94. The McMahon Mission assembled an historical record of the lower Helmand River by questioning local inhabitants, from travelers' reports, from computations based on high-water marks, and from flow observations. This historical information is presented below in the order of descending accuracy of the information from the years of the McMahon Mission to the early years for which the information is less reliable. The year is not a calendar year but a water year; thus 1905 is the period October 1, 1904, to September 30, 1905.

1905 (October 1, 1904, to September 30, 1905). Dry year, i.e. a year of poor spring flood. The estimated runoff of the lower Helmand

River was 2,893,000 acre feet. The volume of the river fell to about 300 c.f.s. at minimum stage. At the height of the hot season no water went down the Nad-i-Ali channel and the Rud-i-Pariun for about 2 months.

1904 (October 1, 1903, to September 30, 1904). Normal year. The estimated runoff in the lower Helmand River at Kohak was estimated as 4,453,000 acre feet.

1903 (October 1, 1902, to September 30, 1903). Moderate spring flood. The estimated runoff in the lower Helmand River at Kohak was estimated as 7,091,200 acre feet.

1902 Drought. The river was dry below Rudbar (50 miles upstream from Band-i-Kamal Khan) for nearly 3 months.

1901 Dry

1900 Normal

1899 Dry

1898 Normal

1897 Normal

1896 High flood

1895 High flood

1894 Normal

1893 Dry

1892 High flood

1891 High flood

1890 Normal

1889 Moderate flood

1888 Moderate flood

1887 Normal

1886 Moderate flood

1885 (October 1, 1884, to September 30, 1885). Extraordinary flood. From information gathered in Seistan in 1902–1905 the volume of

this flood was estimated by the irrigation officer of the McMahon Mission as much greater than any other flood of recent times. Flood waters were so high that water flowed from the Helmand River just below Band-i-Kamal Khan through the old Rud-i-Biyaban trough to Gaud-i-Zireh.

1884 Dry

1883 Normal

1882 Normal

1881 Normal

1880 Moderate flood

1879 Normal

1878 Normal

1877 High flood

1876 Normal

1875 Dry

1874 Dry

1873 Normal

1872 Dry

1871 Drought. For a period of 40 days no water flowed in the Helmand River below Chaharburjak.

1865 Major flood

1838–1844 During one year of this period the river was dry for an interval of 22 days below Kala-i-Fath.

95. The Helmand River Delta Commission notes that the irrigation officer of the McMahon Mission in 1902–1905 endeavored to develop an estimate of the average flow of the lower Helmand River. The method used was to classify all of the years between 1872 to 1901, inclusive, into one of five types, i.e. dry years, normal

years, years of moderate flood, years of great flood, and years of extraordinary flood. These classifications were based primarily on the information remembered by local residents during the survey, 1902–1905. The irrigation officer of the McMahon Mission arbitrarily assigned to each type of year certain monthly discharge values. On the basis of these assigned values, average flows of the lower Helmand River were computed for the spring crop season and the autumn crop season for the period between the major drought years of 1871 and 1902. Neither of the drought years was included in this average figure.

96. Such extension of the observed stream-flow record is much too approximate for present day use. Accordingly, this Commission has drawn conclusions from only the 1947–1950 discharge records and the historical records of the McMahon Mission, 1902–1905, as summarized herein.

Attempt at Expansion of Hydrologic Data

97. The Helmand River Delta Commission has considered the expansion of the basic records of the Helmand River runoff to cover earlier years by correlating runoff with rainfall. Unfortunately, Kabul, Afghanistan, the only meteorological station near the headwaters of the upper Helmand River, is on the other side of the divide and at too low an elevation to indicate adequately the precipitation which occurs largely in the form of snow in

the high mountain headwaters of the Helmand River. Other existing meteorological stations of long duration are more distant from the Helmand River watershed and do not reflect the orographic precipitation of the upper Helmand River.

98. The Commission has also considered possible comparisons of the Helmand River watershed with other river basins, but has not found adequate records for other rivers so situated that a reasonable comparison could be made.

Summary of Hydrologic Information

99. The records and estimates on which the present analyses in regard to the water supply of the Helmand River in the delta area have been based may be summarized as follows:

Historical estimate of runoff for period 1838–1905.

Historical estimate of runoff for period 1927–1950.

Discharge record for the Helmand River at Kohak for 3 water years: October 1902 through September 1905.

Discharge record for the Helmand River at Chaharburjak for 4 water years: October 1946 through September 1950.

The discharge data for the Helmand River at Kohak, October 1902–September 1905 and for the Helmand River at Chaharburjak, October 1946–September 1950, are summarized in Tables 6 and 7.

Conclusions Regarding the Water Supply of the Helmand River

100. The water which reaches the lands of the Delta originates primarily in the high mountain mass of central Afghanistan in the watershed of the upper Helmand River above Kala-Bist. Although some flood water in varying amounts is contributed to the Helmand River at Kala-Bist by the Arghandab River during the months from February to June, no water of any consequence enters the Helmand River from the Arghandab channel in the months from July through January each year. The only water which might enter the Helmand River below Kala-Bist would result from desert storms directly over the narrow trough in which the river flows or in a few areas which drain to the main river. As the annual rainfall over these deserts is negligible, any such contribution to the water supply of the lower Helmand River may be disregarded. It appears that little change has occurred during the last half century in depletions of the Helmand River flow for agricultural and other purposes either upstream from Band-i-Kamal Khan or in Chakhansur and Seistan, prior to the first test diversions in the new Boghra Canal at Girishk in March 1950. Therefore the recorded stream-flow data prior to that time establish the pattern of the traditional water supply of the Helmand River to the delta area below Band-i-Kamal Khan.

Annual Cycle of the Helmand River

101. The annual cycle of the Helmand River in the delta area is as follows:

October through January—The river rises slowly and steadily from the low discharge of early autumn, due principally to the decrease in both evaporation and upstream uses.

February through May—During these months the discharge of the river reaches its maximum from snow-melt floods, and flows are ample throughout these months. Although an occasional sharp flood peak has occurred in these months, it appears that the usual spring crest is long and rounded. The river frequently starts to recede in April although in some years, as in 1950, the crest of the spring rise occurs in May. It is important to note however that the time of occurrence of the spring crest will greatly influence the monthly discharge in July, August, and September; an early crest will be followed by lower stages in July, August, and September than a later spring crest of equivalent magnitude.

June through September—The river declines steadily and rapidly from the spring crest to a summer low in July, August, and September. In years of small spring flood the late summer flow can be expected to be less than in years of normal or large spring flood.

Normal Annual Flow of the Helmand River

102. The present-day record of the discharge of the Helmand River—4 water years—is far too short a period for accurate conclusions to be drawn as to a "normal year" on the Helmand River. It will be possible to estimate more accurately the normal annual runoff after a number of additional years of record have been obtained.

103. The Commission was told by the local people, while it was traveling through the delta area, that the river flow since the drought of 1947 had been more or less normal. Lack of water in the canals late in 1950 was explained as due to the continued lowering of the river bed and water surface and the lack of cooperation across the border in building a common brush dam to relieve the situation. Certainly the water as observed by the Commission that was going to waste down the Rud-i-Seistan was more than ample to meet all irrigation requirements at the time. Apparently there were no shortages previously experienced during these 3 years except possibly those due to difficulties incident to getting the water into the canals.

104. It can be assumed therefore that the flow records of these 3 years—1947–1948, 1948–1949, and 1949–1950—represent about normal conditions. The average annual flow during these 3 years at Chaharburjak was approximately 4,800,000 acre feet. At no time within this 3-year period was the monthly flow at Chahar-

burjak, less than the total irrigation requirement as calculated.

105. No direct comparison can be drawn between the flow records of 1947–1950 and earlier records of 1903–1905. Calculations of flow were made by the McMahon Mission at some point upstream from Kohak, but the 3-year record—1902–1903, 1903–1904, and 1904–1905—was made under rather crude stream-flow measuring practices as compared with modern practice in which greatly improved equipment is used. Also the Mission's estimates include only one year that approaches normal conditions. The other two years depart rather widely from the normal, one 147 percent and the other 60 percent. The flow during the period 1947–1950 departs from the normal only as follows: 77 percent, 112 percent, and 110 percent. The flow during the early part of the water year 1902–1903, as estimated by the McMahon Mission, appears inconsistent with known facts. The first measurements made in the year 1902–1903 were in February after the Mission first reached the area. Records for the first few months were therefore of necessity estimated by the McMahon Mission. These months immediately follow one of the most severe droughts in the history of the river. The estimated figures given by the McMahon Mission for these few months are apparently much too high. Therefore any correction for such estimates would lower the average for this 3-year period. Allowing for a seasonable increase in the fall flow following the severe drought during the

summer of 1902, it is now estimated by the Helmand River Delta Commission that the runoff for the 1902–1903 water year was approximately 6,550,000 acre feet, and the average for the 3 years was about 4,630,000 acre feet. Since the average flow for the water years 1947 to 1950 at Chaharburjak is approximately 4,800,-000 acre feet, it may thus be seen that the total flow reaching the Delta is about the same now as it was some 50 years ago.

106. While the total flow appears now to be about the same as it was in past years "traditionally", there seems to be some shift in the seasonal flow. Under present-day conditions it appears that the summer flow is somewhat lower than it was in the time of the McMahon Mission, and the winter flow is correspondingly higher. The accuracy of the figures presented however is so doubtful that a direct comparison of flow records during the late summer and fall months is not justified. It is possible that this general reduction in the summer and fall months may be the reflection of increased upstream diversions that have been developed since the McMahon Mission was in the Delta in 1902–1905, although no evidence of any recent expansion was noted by the Commission while in Afghanistan in 1950.

Critical Drought Years

107. From the historical record it appears that the drought which occurred in the Helmand River watershed in 1902 was far

more critical than the drought of 1947 and probably the worst drought during the last century. Since four critical droughts (1947, 1902, 1871, and between 1838–1844) are recorded in a period of 112 years, it appears that a drought as critical as the one in 1947 may be anticipated on an average of once in 28 years. A drought such as that which occurred in 1902, when the Helmand River was dry below Rudbar for nearly 3 months, may be expected to occur about once in each 100 years.

108. The recurrence of such critical droughts is very important to note, since it is only in the years of drought, which occur infrequently, that trouble and misunderstanding over the division of the water between the two countries are liable to develop. Even with Kajakai storage dam in operation it is possible on rare occasions of extreme drought that there may be a failure of water supply for a short period in the delta area.

Major Flood Years

109. The greatest flood in the Helmand River during the past 100 years occurred in 1885. Records are not available from which the magnitude of that flood or the areas of its origin can be accurately determined. However it is reasonable to assume that the entire watershed of the Helmand River above Kala-Bist must have contributed flood runoff to produce such a major flood in the Delta.

110. The largest flood in recent years appears to be that of 1939 when lake levels in the delta area reached a very high stage. Much land in the delta area, normally irrigated, was under water.

111. While floods in the past have caused and do regularly cause trouble from overflow and breaking of canals and headings, it is probable that after the developments now in progress upstream are completed there will be almost complete mitigation of this problem from minor floods. It is to be noted at the same time that the storage upstream now contemplated cannot provide full flood control. Major floods which originate far toward the headwaters of the Helmand River can be only moderately reduced in peak and volume by the reservoirs that are under construction. Should such a flood ever occur in the future as did come down the river in 1885, the damages to the irrigation in the Delta would be fully as high as those which were actually experienced at that time.

The Traditional Water Supply of the Helmand River Delta

112. The conclusions stated above define the traditional water supply which the Helmand River brings to its Delta. As has been shown the most reliable records cover only the 4 years from October 1946 through September 1950, but conclusions drawn from these records are supported by the less reliable data collected by the McMahon Mission, 1902–1905 and by the historical estimates compiled from available sources.

Present Day Water Supply of the Helmand River Delta

113. The present-day water supply of the lower Helmand River is defined by the record at Chaharburjak for the period October 1946 through September 1950. The water supply of the Delta can be more firmly established as additional records are secured at Chaharburjak and Kohak.

Hydrologic Data—Future

114. As long as the flow of the Helmand River remained uncontrolled and flood waters of each year passed through the Delta to the lakes, the only place a record of the discharge of the river was considered necessary was in the delta area insofar as the international phase of the use of the water was concerned.

115. With the completion of the Kajakai storage dam some 300 miles above the head of the Delta by the Government of Afghanistan, the natural flow in the river downstream from the dam will be changed. In order to determine what the natural flow would have been without the Kajakai Dam in operation, it will be necessary for the Government of Afghanistan to establish some additional gaging stations on a permanent long-term basis. It is suggested, therefore, that a permanent water-stage recorder station be established at the Kajakai Dam which will give a continuous record of the elevation of water in the reservoir. Also a permanent water-stage recorder and discharge measuring station should be established at a point upstream, away from any

possible influence of backwater from Kajakai Dam. This latter station should be put in operation immediately in order to permit coordination of the records with the present station at Kajakai for the period before the dam is built. The gaging station upstream from the Kajakai reservoir will give a continuous record of the natural flow of the Helmand River. The data obtained will be valuable in future hydraulic studies, as well as serving as a basis for determining annually in advance the type of water year to be expected.

116. In view of the fact that the flow in the delta of the Helmand River is of prime concern to both countries, it is suggested that an "international gaging station" be established in the most suitable stretch of river some five to ten miles above Kohak, well above the influence of backwater from diversion dams. This station should be of a permanent nature, including a modern water-stage recorder and a cableway from which meter measurements of discharge may be made. The station should be operated by qualified engineers of both countries.

117. It is considered desirable that a permanent record be secured of the relative distribution of the water between the Rud-i-Seistan and the Common River, which could best be determined by measuring the flow of the Common River a short distance downstream from Kohak. It is suggested that an "international gaging station" be established, including a modern water-stage

recorder and a cableway from which meter measurements of discharge may be made, at the most favorable site on Common River, not more than five miles downstream from Kohak.

118. It is considered essential that the existing gaging stations on the Helmand River below Kajakai Dam and at Chaharburjak and also on the Arghandab River near Kala-Bist be continued. A daily record of the amount of water used in the Boghra Canal will also be required to permit comparison of the river flow at the various gaging stations from above Kajakai to Kohak.

119. As an aid in forecasting the anticipated annual runoff, the establishment and maintenance of a series of permanent snow courses in the mountains at the headwaters of the Helmand would be helpful.

120. The possible existence of suitable ground water in the area has not been explored. It is believed that a supply adequate for domestic use and stock water might be available through deep wells. A series of such wells to determine this potentiality and possibly to provide for domestic consumption during periods of extreme drought should be considered by both countries.

TABLE 6

MONTHLY AND ANNUAL RUNOFF OF THE HELMAND RIVER AT CHAHARBURJAK

Runoff in Acre Feet

Month	*Year 1946–1947*	*Year 1947–1948*	*Year 1948–1949*	*Year 1949–1950*
October	37,500	25,200	38,060	52,020
November	50,000	40,500	55,400	64,740
December	71,300	62,000	71,800	83,480
January	92,000	80,000	99,770	90,190
February	194,000	150,000	227,400	463,100
March	418,000	725,000	1,184,000	535,400
April	530,000	1,458,000	2,146,000	1,163,000
May	320,000	835,000	1,057,000	1,814,000
June	93,300	216,000	313,200	671,000
July	15,400	55,300	114,300	208,300
August	300	30,800	57,230	97,290
September	1,500	23,800	42,570	67,480
Annual	1,823,300	3,701,600	5,406,730	5,310,000

TABLE 7

MONTHLY AND ANNUAL RUNOFF OF THE HELMAND RIVER AT KOHAK, 1902–1905

Runoff in Acre Feet (From the *Seistan Irrigation Report*, VOL. I)

Month	*Year 1902–1903*	*Year 1903–1904*	*Year 1904–1905*
October	124,000	129,000	89,000
November	165,000	152,500	108,000
December	186,000	167,200	151,000
January	248,000	214,200	153,000
February	252,000	271,000	176,000
March	420,000	541,000	312,300
April	1,570,000	1,245,000	440,000
May	2,428,000	1,037,000	849,000
June	992,500	406,600	402,000
July	384,000	139,400	134,300
August	208,100	78,000	44,000
September	113,600	72,000	34,400
Annual	7,091,200	4,453,000	2,893,000

CHAPTER VIII

Water Requirements in the Delta

Irrigation Practice

121. In a region of the world where water is universally scarce, the farmers in the delta of the Helmand River have worked out as the result of experiments throughout the centuries the one agricultural economy most appropriate to that area. This involves winter cropping, which requires less water because of the lower temperatures, lower evaporation, and less wind. Winter wheat and barley, planted in the fall and harvested before the extreme heat of summer, take full advantage of each of these climatic factors. The period of low flow in the river usually occurs during the late summer months, with the river being completely dry at this time on rare occasions. Planting of wheat and barley is staggered through the fall months as the flow of water in the river increases.

122. Summer crops aside from cotton are limited to melons, beans, corn, garden vegetables, and orchards which are produced to relieve the grain diet of the local inhabitants, but which have to be cultivated under severe climatic conditions of wind and heat.

Typical desert characteristics prevail, including high temperatures, strong and continuous winds, and normally a dwindling water supply as the summer advances. It frequently occurs that crops planted in the early summer, when there is plenty of water in the river and in the canals, fail to mature properly due to shortage in the late summer water supply.

123. The water supply needed for the production of the selected crops as now produced is fairly well established. Due to the severe climatic conditions, which man cannot alter, there is little prospect for any wide-scale change in the relative proportions of these crops from a winter to a summer economy.

124. The depth of water supplied on the land in each irrigation, as indicated by the irrigators in meetings before the Commission and also by the government officials who reported upon the situation, is approximately 4 inches (10 centimeters). In this respect the irrigation practice in the Delta does not depart materially from standard practice under similar conditions elsewhere in the world. It is emphasized that in any country that has been irrigated as long and continuously as this particular area, present customs in the application of water have been determined as the result of long experimentation and probably represent the highest economic returns for the effort in labor expended.

125. The number of applications required to mature the crops depends somewhat upon variable weather conditions that change

during the growing season, such as temperature, wind, and rainfall. For wheat and barley, which are the winter and principal crops, the average number of applications for the season is from four to six, including the watering of the soil preparatory to planting. The summer crops, because of the crops themselves and also because they are grown coincident with higher temperatures combined with the 120-day wind, usually require more applications, ranging from eight to twelve in number.

Basic Water Requirements

126. The Commission has considered the water requirements for each of the crops that are annually produced in the Delta. Figures furnished by the Independent Irrigation Administration of Iran in the report "Irrigation Water Required Annually in Seistan" and data furnished through the Public Works Department of Afghanistan were carefully checked and found to be comparable to the requirements for similar crops in other parts of the world. Based on the above figures, it is the judgment of the Commission that the net requirements for the various crops at the farm, as now irrigated in the Helmand River Delta, are as follows:

Crop	*Irrigation water required at the farm in acre feet per acre*
Wheat and barley	1.65
Cotton	2.70
Corn	2.00
Melons	3.00
Beans	3.00
Broad beans	1.60
Mung beans	1.60
Orchards	2.50

127. As derived these figures are for the full consumptive use, including annual precipitation. However because of the small amount of rainfall in the Delta and its erratic occurrence, no deduction has been made therefor. The resulting figure for wheat and barley is approximately 10 percent higher than is actually necessary in other than drought years, because the rainfall of about two inches is coincident with the growing season of these main crops.

Water Losses in Irrigation

128. The water delivered to the farms, however, constitutes only a part of the water necessary for irrigation. There must be supplied ample water from the source to provide not only the farm requirement but also that which will take care of conveyance and other losses while getting the water to the farms. While these losses are made up of many different separate items, the total loss can best be calculated in terms of the many items combined. The separate items that go to make up the total losses of irrigation water while in transit from its source to the farm are:

Evaporation from the water surface.
Deep seepage or percolation loss.
Consumptive use by native vegetation.
Waste through careless practices.

All of the above-named losses, which take place incident to the delivery of water for irrigation, depend upon and vary with the lengths of the canals, more or less in the same proportion.

129. Evaporation from the water surface varies with the season, being much higher during the summer months. It also varies in proportion to the surface exposed. In the delta area evaporation from the water surface of the canals and channels is quite high on an annual basis. This is caused primarily by the severe winds during the summer months. Other climatic phenomena which influence evaporation are not more severe in this region than in many other areas on the earth's surface. Happily however the larger irrigation requirements are not coincident with these winds, but they occur during the winter months while the evaporation losses are more normal. The evaporation losses in the conveyance channels incident to the irrigation of wheat and barley are considered as normal or lower than normal.

130. The evaporation from the water surface of the canals during the summer irrigation would be relatively large because the unfavorable climatic factors combine at that time to make evaporation quite high. However since the area irrigated in summer is small and many canals are dry, the over-all loss incident to summer irrigation would not prove to be excessively high.

131. In regard to the proportionate area of water surface exposed in the canals and the channels, two quite different characteristics were noted during the visit of the Commission. The river and distributary channels, where used as canals, were relatively wide and shallow. On the other hand the canals were compara-

tively narrow and deep. Since the canals far outnumber the river channels, it is apparent that the water surface exposed to evaporation is on the low side rather than extraordinarily high.

132. The area irrigated in the delta of the Helmand River is rather compact and the canals are not of excessive length. Accordingly the losses as proportioned to length would be low or less than normal.

133. Deep seepage or percolation losses in the delta area are practically nonexistent. This fact is best indicated by the existence of the lakes adjacent to the area on the north and west. These lakes overlie the same soil as that of the irrigated area of the Delta. These soils are highly impervious, as further evidenced by the following visible characteristics:

> The channel and canal banks stand vertically.
> The soil is adobe—as evidenced by the sun-dried brick used in the area.
> The ruins of ancient civilizations built of mud still stand through the centuries against erosion by both wind and water.

All of the above characteristics denote a high quantity of clay in the soil, which gives it that impervious quality. These soils are described in some detail in chapter V, paragraph 49, "Soils."

134. Based on the foregoing evidence, it is quite clear that the soils of the delta area are highly impervious. Losses from deep percolation are considered very small.

135. The consumptive use by native vegetation is limited to a narrow fringe along both banks of the canals and channels be-

cause of the highly impermeable quality of the soil. The consumptive-use loss to this native vegetation is considered normal or less than normal.

136. The following conclusions are reached with respect to the losses discussed above, all of which are incident to the delivery of water to the farms and which are more or less independent of the manner of irrigation or the methods used in its practice:

Evaporation—normal or less.
Deep percolation—very small.
Consumptive use by native vegetation—about normal or less.

These elements combined would indicate no more than the usual losses incident to irrigation in a desert region. There is a great volume of information on this question available from experience in different parts of the world, upon which a reasonable estimate can be based.

137. Waste through careless practices, the fourth item of loss, is highly variable both as to time and place. Practices used near the heads of the canals, where the water is more plentiful, are not the same as those near the tails of the canals where ample water is not always available. When water is scarce it is always handled more carefully. Some wasteful losses are breaks in the banks of canals and breaks in field embankments, which are very noticeable when they occur because they frequently flood the roads. A small amount of such losses is unavoidable.

Total Water Losses

138. The Commission concludes from its study of the Delta that a well-developed irrigation project in the area, with the tight and impervious soils and with adequate regulation to control waste, would probably experience combined losses less than 35 percent of the diversions. A difference between the primitive area in the Delta and a highly developed project must be recognized. Efficiency of any project in irrigating from an unregulated and erratic stream, being dependent wholly upon the natural flow, is never as high as might be obtained where full control has been established. Furthermore, where the canals are also uncontrolled, as is true of the Delta, the wastes, particularly at the ends of the canals, would tend to be high, and the total losses would consequently be high. The Commission concludes that, in computing the water requirements which have prevailed in the area, total losses in conveyance of water from the main point of diversion to the lands may be said to average 50 percent of diversions.

Traditional Water Requirements in Seistan and Chakhansur

139. The "traditional" irrigation in the Delta has been defined in the Notes of the Meetings held in Washington, D.C., by representatives of Afghanistan and Iran from August 9 to September 7, 1950, as follows:

> By that (traditional) we mean the irrigation practices, the types of crops, extent of land, availability of water supply in the river during the various cycles of dry and wet in the past 80 years, the origin of time being the year 1872.

140. The traditional acreage irrigated annually in the delta area has been discussed in chapter VI and shown to total about 190,000 acres, of which 149,000 acres are located in Seistan and 41,000 acres are in Chakhansur. It must be recognized that a full water supply was not always available to this total acreage and that frequently lands at the tails of the canals, or otherwise unfavorably situated, received only a portion of the full annual requirement necessary to obtain the best crop yields. However, it is considered desirable to compute the "traditional" use established in the Delta on the basis of the entire average acreage receiving annually the full requirement for best yield.

141. The distribution of the crop acreage during these years is based on the distribution of crops found by the McMahon Mission. This distribution for Seistan is verified by the distribution given in the 1950 Iranian Report, "Irrigation Water Required Annually in Seistan." Although it was obvious to the Commission that a change is taking place today in Chakhansur, it is believed that the McMahon distribution is fair for that area on the average. The distribution of the traditional crop acreage is as follows:

Percentage of the Total Area in Specified Crop

Crop	In Seistan		In Chakhansur
	McMahon Report	1950 Iranian Report	McMahon Report
Wheat and barley	86.5	87.1	72.0
Cotton	3.3	1.4	12.0
Corn	2.5	1.7	6.0
Melons	6.7	6.5	6.5
Beans and gardens	1.0	1.7	3.5
Orchards	.....	1.6	.....
	100.0	100.0	100.0

142. On the basis of the above percentages of the various crops, the traditional water requirements for irrigation in Seistan and Chakhansur may be computed. The average water requirement at the farm in Seistan is 1.78 acre feet per acre and in Chakhansur 1.94 acre feet per acre.

143. The water requirement at the farm for the traditional average of 149,000 acres irrigated in Seistan is found to be 265,000 acre feet. The traditional diversion requirement based on delivery starting at Kohak, and assuming an average loss of 50 percent, is 530,000 acre feet.

144. The water requirement at the farm on the traditional average of 41,000 acres in Chakhansur is 80,000 acre feet. Based on an average loss of 50 percent, the traditional diversion requirement beginning at the established points of diversion along the river from Band-i-Kamal Khan to Kohak is 160,000 acre feet.

145. These traditional diversion requirements for Seistan and Chakhansur are considered to be liberal estimates of the volumes

of water put to beneficial use in these areas on the average over the last 50 years. As has been shown, these estimates are based on the entire acreage receiving the full water requirement for maximum crop yield. It is again noted that the farm requirements are liberal for other than dry years, as the rainfall received during the growing season of wheat and barley has not been deducted.

Monthly Distribution of the Traditional Requirements

146. The monthly distribution of the traditional water required varies somewhat on different sides of the border. In Iran there is comparatively more use of water in the winter months, as indicated by both the 1950 Iranian Report and the McMahon Reports. This distribution in percentage of the annual total for Seistan from the 1950 Iranian Report, which reflects the progressive planting of wheat in this subprovince, and the application of these percentages to the annual requirement, are shown in Table 8.

147. In converting the months of the Gregorian calendar as shown in Table 8 and in Tables 9, 10, and 11 which follow to the Iranian calendar, October would correspond with Mehr, and in reference to the Afghan calendar, October would correspond with Mezan.

TABLE 8

TRADITIONAL ANNUAL DIVERSION REQUIREMENTS[1]
SEISTAN, IRAN

Month	*Percent of total*	*Requirement in acre feet*[2]	*Average rate in c.f.s.*[3]
October	1.6	8,500	140
November	4.0	21,200	360
December	7.7	40,800	670
January	11.5	61,000	990
February	23.4	124,200	2,240
March	24.4	129,200	2,110
April	10.0	53,000	890
May	2.9	15,300	250
June	6.3	33,400	560
July	4.5	23,800	390
August	3.0	15,900	270
September	0.7	3,700	60
Annual	100.0	530,000	.....

[1] Based on traditional 140,000 acres.

[2] It is assumed that this figure includes the requirement for domestic use and stock water.

[3] These figures have been adjusted to the nearest ten c.f.s.

148. The uses in Afghanistan, showing relatively higher summer requirements, are distributed in Table 9 in terms of percentage:

TABLE 9

TRADITIONAL ANNUAL DIVERSION REQUIREMENTS[1]
CHAKHANSUR, AFGHANISTAN

Month	*Percent of total*	*Requirement in acre feet*[2]	*Average rate in c.f.s.*[3]
October	1.3	2,100	30
November	3.1	5,000	80
December	5.9	9,400	150
January	8.8	14,000	230
February	17.8	28,500	510
March	19.0	30,500	500
April	10.5	16,800	280
May	5.4	8,600	140
June	12.6	20,200	340
July	8.9	14,200	230
August	6.5	10,400	170
September	0.2	300	5
Annual	100.0	160,000	...

[1] Based on traditional 41,000 acres.

[2] It is assumed that this figure includes the requirement for domestic use and stock water.

[3] These figures have been adjusted to the nearest ten c.f.s. except for September.

Present Water Requirements

149. There has apparently been a change for the worse taking place in the irrigation system in the Delta in the nearly 50 years since the McMahon Mission observed it. As previously mentioned in the chapter on "Agriculture in the Delta," the canal system has undoubtedly been allowed to deteriorate. A part of this deterioration, which was noted by the Commission while in the field and was further described in the talks with the local

representatives of the farmers, is the continued lowering of the river channel, which is making it always harder to make the required diversions. A second cause of the deterioration is probably the movement of loose sand across the Delta, with the consequent blocking of canals and sometimes the complete obliteration of the previously irrigated lands. Another factor which has no doubt contributed to the general breakdown and decay of the irrigating systems is the lack of cooperation between the citizens (and irrigators) of the two lands.

150. Here on both sides of the river are kindred people of similar language and with the same customs and living conditions. Now set apart by an arbitral boundary, they have allowed this artificial line to become a barrier to the simple operation in the joint irrigation of the Delta, which was mutually beneficial to the people in both countries for so long a time. An illustration of this utter lack of cooperation may best be obtained from the claims and counterclaims that were made before the Commission in November 1950 by officials on the opposite sides of the border. In Afghanistan it was claimed that the Iranians were taking all of the water, while in Iran the Afghans were blamed for the present difficulties because they would not take their share of the water. Through this lack of cooperation large volumes of water were wasting into the lakes in Iran in November 1950 to serve no further useful purpose, the lakes already having reached a high-

water surface elevation, while dry canals were in evidence in Afghanistan and the planting of the winter wheat was being delayed.

151. In spite of the general deterioration of the irrigation systems in the Delta, and particularly in Afghan Chakhansur, the acreage that is irrigated as a whole continues about the same. There has been possibly a small increase in the acreage irrigated in Seistan, accompanied by some decrease in the acreage annually irrigated in Chakhansur. Best available figures on the distribution of acreage in the two countries as of 1950 indicate it to be as follows:

Seistan	154,000 acres
Chakhansur	36,000 acres
Total	190,000 acres

152. The unit water requirement for average conditions as above derived for traditional use is also appropriate for the present-day requirement. This was found to be 1.78 acre feet per acre for the distribution of crops then grown in Seistan and 1.94 acre feet per acre for the crops in Chakhansur. No information is available to indicate that the distribution is any different now from what it was then. The water requirement at the farm in Seistan is thus found to be 275,000 acre feet for present conditions, while in Chakhansur the water requirement is 70,000 acre feet at the farm.

153. The losses in the delivery of this water due to evaporation, deep percolation, and consumptive use by native vegetation would have approximately the same relation to the diversion requirement today as was calculated for the earlier period. Wastes due to irrigation practices, which might have been improved upon, have probably become greater instead, due to the general deterioration of the canal system. It was repeatedly pointed out to the Commission while traveling through the Delta that the usual custom in irrigation was to take water on a 24-hour basis—thus irrigating around the clock. This information was consistently given in both Chakhansur and Seistan in answer to inquiries raised by the Commission, before the village representatives in conference and also the government officials who accompanied the Commission. In Seistan it was further pointed out by both the village representatives and the government officials that wastes were being carefully watched and no water was passing through the canals into the lakes. Both of these items should afford a reduction in the losses. However no beneficial effect for this reduction has been taken in the following computations of water requirements.

154. Under these circumstances it is possible that 50 percent of the water diverted is still lost in conveying the farm requirement. The total water requirement annually for Seistan, based on deliveries at Kohak, is 550,000 acre feet. The requirement

for Chakhansur, based on the established points of delivery from Band-i-Kamal Khan to Kohak, is 140,000 acre feet annually.

155. The monthly distribution of the water required still varies somewhat on different sides of the border. In Iran there is comparatively more use of water in the winter months, as indicated by the material furnished by the officials of the Department of Irrigation, than is found in Afghan Chakhansur. This distribution in percentage of the total annual diversion requirement at Kohak for Seistan, Iran and the application of these percentages to the annual requirement are shown in Table 10, which also shows the requirement for domestic use and stock water purposes.

TABLE 10

PRESENT ANNUAL DIVERSION REQUIREMENTS [1]
SEISTAN, IRAN

Month	*Percent of total*	*Requirement in acre feet*	*Domestic and stock use, acre feet*	*Total requirement, acre feet*	*Average rate in c.f.s.*[2]
October	1.6	8,800	500	9,300	150
November	4.0	22,000	400	22,400	380
December	7.7	42,300	400	42,700	690
January	11.5	63,500	400	63,900	1,040
February	23.4	129,000	500	129,500	2,340
March	24.4	134,000	500	134,500	2,190
April	10.0	55,000	500	55,500	930
May	2.9	16,000	600	16,600	270
June	6.3	34,500	600	35,100	590
July	4.5	24,600	600	25,200	410
August	3.0	16,500	500	17,000	280
September	.7	3,800	500	4,300	70
Annual	100.0	550,000	6,000	556,000	.....

[1] Based on present 154,000 acres.
[2] These figures have been adjusted to the nearest ten.

156. The uses in Chakhansur, Afghanistan, showing relatively higher summer requirements, are distributed as shown in Table 11 in terms of percentage. To these figures there have been added the monthly requirements for domestic use and stock-water purposes. These monthly requirements for Chakhansur are based on the diversion of one-third of the total annual requirement at established canal headings between Band-i-Kamal Khan and Kohak, and diversion at Kohak of two-thirds of the total annual requirement for use on lands in Chakhansur north of Kohak.

TABLE 11

PRESENT ANNUAL DIVERSION REQUIREMENT[1]
CHAKHANSUR, AFGHANISTAN

Month	*Percent of total*	*Requirement in acre feet*	*Domestic and stock use, acre feet*	*Total requirement, acre feet*	*Average rate in c.f.s.*[2]
October	1.3	1,700	200	1,900	30
November	3.1	4,300	200	4,500	80
December	5.9	8,300	200	8,500	140
January	8.8	12,300	200	12,500	200
February	17.8	25,000	200	25,200	450
March	19.0	26,500	200	26,700	430
April	10.5	14,700	300	15,000	250
May	5.4	7,600	300	7,900	130
June	12.6	17,700	300	18,000	300
July	8.9	12,400	300	12,700	210
August	6.5	9,200	300	9,500	150
September	.2	300	300	600	10
Annual	100.0	140,000	3,000	143,000	...

[1] Based on present 36,000 acres.
[2] These have been adjusted to the nearest ten.

Water Supply to the Lakes

157. An analysis of the flow into the lakes in Iran has been made in connection with the study of the water requirements for irrigation, although the relationship between the two is only incidental. These lakes are of primary importance in the maintenance of their surrounding marsh areas upon which the cattle of certain tribes are normally pastured. During dry periods of low-river runoff the lakes shrink to small size and the people have to move. In years of flood the rise in water surface extends the borders of the lakes and the people have to move again.

158. At the time of the McMahon Mission immediately following a severe drought, there were some 15,000 cattle in Seistan dependent upon these marshes for their pasturage. That Mission estimated that in good years, after the herds had had time to build up, there might be as many as 34,000 head of cattle in these marsh areas. The herds at this time are probably not greater than in the better years in the past. The only cattle in any numbers seen by the Commission while it was in the field were near the village of Adimi, northwest of Zabol.

159. No adequate data are available as to the average water surface area covered by the lakes, nor how extensive the marsh areas around the lakes might be. However the return flow, including wastes from the lower ends of the canals, will average more than 200,000 acre feet from the irrigation in Iran if the

traditional diversion requirements of Seistan are supplied. In addition there is the runoff from the streams that enter the Iranian lakes from the north and west which is substantial. The sum from these two sources is sufficient to maintain lakes covering thousands of acres against the losses by evaporation.

160. Just as these lakes have become practically dry in the past, it is equally true that they may be expected to do so in the future. Also it is a fact that floods may be experienced in the future, although not with the same frequency as in the past. As the lakes fluctuate between periods of high and low water, the marshes surrounding these lakes will also expand and contract. The tribes dependent upon them will find it necessary to move from time to time, although any stabilization of the irrigation should improve their condition, and the construction of dams upstream will undoubtedly afford some relief from the smaller floods.

161. The full requirement for irrigation in Seistan as presently practiced is 550,000 acre feet, which is undoubtedly as much or more water than at any previous time has been beneficially used for irrigation. Recognition is made of past uses in the flooding of the marshes upon which cattle are normally pastured. Thousands of acres of this marsh land can be maintained for the continued pasturage of cattle from the return flows and waste resulting from diversions of the full traditional requirement for

irrigation, supplemented by the inflow from other streams which enter the lakes from the north and west. All water in excess of this 550,000 acre feet which has passed through the canals and distributaries in Iran to the lakes has served no useful purpose but has been dissipated into the air by evaporation. The alleviation of floods in the lower river would do much to stop this tremendous waste of water, at the same time making the water more readily available for irrigation use.

CHAPTER IX

Developments in Progress or Contemplated

162. Present plans and proposals for development in irrigation from the Helmand River in Afghanistan include: control of the flood flow by storage in a reservoir to be created by Kajakai Dam; construction of a dam on the Arghandab River for storage; extension of irrigation to the Boghra Bench; expansion under the Seraj Canal; expansion of the irrigation along the Helmand River below Girishk to the Delta; and a large development in Chakhansur. The program for development in Iran includes: the construction of two permanent dams on Rud-i-Seistan, the Miankangi and the Zehak; development of storage in the Chahnimeh depression; and the expansion of the irrigated area throughout Seistan.

163. The construction of hydraulic works can be carried out as is seen fit by either country. The usefulness of the structures and the expansion of irrigated areas are dependent on the runoff of the river. In this respect, the Delta of the Helmand River is no different from many areas at the lower end of rivers elsewhere in the world. Land areas, beautifully situated for irrigation,

built up of fertile soils and climatically located for the bountiful production of crops, will forever have to remain barren because the water supply is inadequate and limited. The water supply of the Helmand River is very definitely the limiting factor to future expansion of the irrigated areas. Such expansion as may be possible will have to be designed in strict regard to the available water supply.

164. The present plans and proposals for development in the Helmand River Delta, as described by officials of Afghanistan and Iran, include expansion far in excess of the capacity of the water supply. Such ideas of expansion in this area are not new. Past history, as indicated by the ruins of ancient cultures and the irrigation works of long-since departed civilizations, is replete with the evidence of struggles to make such dreams come true. The remnants of these past civilizations speak for themselves of the limiting factors which controlled the growth and endurance of former cities and give some clue to the characteristics which have ever acted as a curb to further expansion. These limits, which may best be described as climatic conditions of the region and which have been previously discussed, are no doubt as effective today as they have been in the past.

In Seistan

165. The Independent Irrigation Administration of Iran has designed two diversion dams to be located on the Rud-i-Seistan.

One of these dams was under construction in November 1950 and a contract has been let for the construction of the other. These dams will be located 2 kilometers and 15.7 kilometers respectively downstream from the head of the Rud-i-Seistan at Kohak. Each is similar in plan, consisting of a series of flat tainter gates designed to raise the low flow of the river to insure deliveries of water into existing canals. Present plans provide for gates two meters in height on both dams, with the provision that these gates may be increased to four meters on the upper dam at a later date.

166. The *upstream dam,* to be known as *Miankangi,* is now under construction two kilometers from the bifurcation of the Helmand River at Kohak. It will consist of nine gates. This dam is designed to insure deliveries from the Rud-i-Seistan to the Azar Canal. An auxiliary purpose, for which the height of the gates would be increased, is to raise the water surface upstream at Kohak to permit a proportionate flow down the Common River (Rud-i-Pariun).

167. The downstream dam, to be known as *Zehak,* has been contracted for but had not been started at the time the Commission visited this area. This dam, to be located 13.7 kilometers downstream from Miankangi Dam, will have eight gates. It will raise the water surface in the Rud-i-Seistan to insure deliveries of water into the Zehak Canal, which serves Zabol on the right

bank, and into the Chahnimeh Canal on the left bank.

168. The Chahnimeh Storage Basin is being considered by the officials of Iran for the development of off-channel storage in a large depression west of the Helmand River and south of the Rud-i-Seistan. About 500 acres in this basin are being cultivated by the inhabitants of the village of Chahnimeh. Water for this irrigation is brought to the depression along a narrow trough from the Rud-i-Seistan. In the flood of 1939 water from the Rud-i-Seistan flowed through the trough into the depression.

169. The officials of the Independent Irrigation Administration of Iran have indicated that only preliminary consideration has been given to this proposed storage project and that further study must be made to determine the feasibility of the project. It is probable that with the change in the seasonal distribution of the flow of the Helmand River with completion of upstream storage this small storage development in Seistan would not be warranted.

170. In planning the general improvement of the irrigation in Seistan consideration should be given to revision of the entire system of main canals, laterals, and farm ditches to achieve a higher efficiency. Studies to determine drainage requirements and proper water-application processes to combat the "white alkali" problem in Seistan are essential. Such improvements as the combination of long parallel canals, drainage and better-

ment of laterals, if pursued immediately, together with the two diversion dams under construction, will bring early benefits. Construction of major works as a part of an improvement of the entire area of Seistan might be considered after the effects of upstream storage become evident.

In Chakhansur

171. The canals now serving lands in the upper part of Chakhansur, those which have developed headings on the river between Band-i-Kamal Khan and Kohak, are not experiencing any undue difficulties in making their diversions. The thing most needed for those canals which take out of the Common River downstream from Kohak, or its distributaries, is an assured water supply. Such an assured supply can be furnished when storage at Kajakai becomes effective. The difficulties of making diversions will not be over, however, until some control works are placed in operation in the Delta. The construction of Miankangi Dam in Seistan, with the higher gates in place, could provide for a proportionate part of the low flow of the main river to enter the Common River. It appears that through such cooperation many of the existing difficulties could be relieved.

172. Consideration of an international diversion dam on the Helmand River just above Kohak, which was discussed with the Commission by representatives of both countries, should be

deferred until experience in the operation of the Miankangi Dam near the head of Rud-i-Seistan has been obtained. It is possible that such an international structure will not be required.

Upstream Developments

173. The two items of construction in progress, or now contemplated, which will have a great effect on the flow of the Helmand River in the Delta, are the dam at Kajakai and the expansion of the irrigated acreage below that point but upstream from the head of the Delta at Band-i-Kamal Khan.

174. Kajakai Dam, approximately 300 miles upstream from the head of the Delta, is being built by the Government of Afghanistan in the canyon section of the river near where the mountains meet the plains. This dam, some 100 meters in height, will impound at full storage level about 3,000,000 acre feet of water. This reservoir will provide substantial control of downstream flow. Excess flows, which generally occur during the period when irrigation demands are relatively low, can be stored for later use as needed. Silt washing down from the headwater area will be retained, thus relieving to some extent the downstream burden of silt. Each of these items will have a beneficial result on the operation of irrigation in the lower river, including the Delta.

175. Plans for the operation of the Kajakai Reservoir are not available, and the Commission does not know just how it will be

handled in practice. Trial operation studies indicate something of the limits in its operation which might be anticipated. It is assumed that a certain portion of its capacity will be allocated for silt control since the accumulation of silt therein will start coincident with the beginning of storage. A further allocation of capacity would be assumed for a certain amount of carry-over storage, which would be called upon and used only in case of a subnormal inflow or short contribution from the upper watershed. No allocation of storage space in the reservoir is known to be made for flood control, although, without any special allocation, there would still be a substantial relief from floods due to the fact that floods generally occur only during the spring months, February to April. At the end of the flood period the reservoir would have reached the point of maximum storage or would be spilling. Subsequently during the next 8 or 9 months there would be a drawdown in the reservoir, with the period of highest irrigation demand coming prior to the next flood season. Consequently by the beginning of each flood season there would be storage capacity available in which flood waters would be captured. Spills of flood water would not occur until this vacated space had been filled, with the result that the flood inflow volume would be appreciably reduced on all ordinary spring floods. Another flood-control benefit would result due to the ponding effect of storage incident to the rise of the water surface above the spillway crest,

even though no allocation of space for this purpose is made. Extreme floods, such as occurred in 1885, would be modified in such a small way that no significant benefit would result.

176. No estimate of the combined capacity that might be made for the above purposes can now be made. But, since the principal purpose for which the dam is being built is to provide conservation storage for irrigation, it may be assumed that a large part of the total capacity in the reservoir will be reserved for that purpose.

177. There is a relation between the average annual flow of a stream and the conservation capacity provided in a reservoir thereon, where there is no further control upstream therefrom, that is fairly well established from the known data available from many streams. This relationship varies somewhat between limits which are dependent upon the general characteristics of the watershed above the dam and the climatic conditions which result in the runoff. If the conservation storage is assumed as 2,150,000 acre feet, these limits, in the average annual water supply that can be made available to fit the needs of irrigation, for the Kajakai Reservoir are between 1,600,000 and 2,150,000 acre feet. A trial reservoir operation study, necessarily based on a number of assumptions and run through the period October 1946 to September 1950, indicates a yield of approximately 2,000,000 acre feet per year for that period. This yield is supported by the

above analysis since it falls within the limits specified. The average annual inflow in excess of this yield of 2,000,000 acre feet will mostly spill.

178. The expansion of the irrigated area along the Helmand River in Afghanistan as now contemplated for the section of the river between Kajakai Dam and Band-i-Kamal Khan will be largely concentrated in the Boghra development. It is evident that all of the new acreage cannot be brought into irrigation immediately. The construction of canals or the improvement of old canals to provide water for this additional acreage has now been started for the Boghra area. Additional canal capacity will not be required until regulation of the water supply is provided in the reservoir upstream.

179. The acreage under the Boghra Canal now being brought under irrigation actually replaces in part lands that were formerly served by the old Boghra Canal. In meeting with the Elders of Girishk at Chah-i-Anjers on October 30, 1950, the Commission learned that this old Boghra Canal had been in service for many years and was broken by the flood of 1885. Attempts to repair it proved costly in labor and it was abandoned within a few years following that flood. Subsequently lands upstream from Girishk that were formerly served by that canal were connected with other canals to continue in operation. Construction of a new Boghra Canal was undertaken about 1936 but was soon suspended.

Construction was started on the present Boghra Canal in 1946. At the time of the visit of the Commission to the project at the end of October, 1950, the first section of this new canal was completed and being seasoned by passing a small quantity of water through it. Information given to the Commission at that time as to the anticipated rate of development of acreage under this canal was essentially the same as previously furnished to the Iranian officials, which was as follows:[1]

> It is planned to colonize and develop these further areas progressively such that by the end of 1950 there will be brought into irrigation a surface of at least 5,000 acres; during 1951, 10,000 more; during 1952, 15,000 more; and during 1953, 20,000 more.

180. Other areas now being irrigated in Afghanistan upstream from the head of the delta on the Helmand River as seen by the Commission, either on the ground or from the air, show every indication of having been irrigated for many years. And, since the small acreage now developed on the Boghra Bench first received water late in 1950, the effect of this expansion has not yet been felt in the Delta.

181. It is significant to note that the flow of the river near the head of the Delta, after the upstream use has been deducted, has averaged during the 4 years of record, October 1946 through September 1950, slightly more than 4,000,000 acre feet. (See records of discharge, Helmand River, for the gaging station near

[1] "The Hirmand River Dispute" (an Iranian report), pp. 30, 31.

Chaharburjak.) During this period the quantity of water annually entering the Delta has varied from 1,823,300 acre feet in 1947 water year to 5,406,730 acre feet in 1949 water year. Irrigation requirements consume only a fraction of this annual inflow to the Delta with the major portion now passing unused through the river channels of the Delta to the lakes, where it is largely dissipated through evaporation. As shown in the previous chapter under the title "Water Requirements in the Delta," the total water that is now beneficially used in Chakhansur and Seistan is approximately 700,000 acre feet annually. Thus it can be seen that the waste water now entering the lakes averages more than 3,000,000 acre feet per year. It is the judgment of the Commission that very little of this water serves a beneficial purpose.

182. When Kajakai Dam is completed and the expansion in upstream irrigation development now contemplated has taken place, the regimen of the river will be changed. Storage of flood flows for later release as required by irrigation will smooth out the erratic flow pattern of the lower river and make a much larger proportion of the total flow fit into the irrigation pattern. These upstream developments will however place additional depletions on the river, with the result that the total flow reaching the head of the Delta will be reduced. A depletion incident to the regulation provided in the Kajakai Reservoir is the evaporation loss

that will take place from the surface of the water in storage. While the loss to the river from this cause is dependent upon the manner of operation, which at this time is unknown, it has been estimated that this loss will be practically 100,000 acre feet annually.

183. The limit of expansion in irrigated acreage, including an increase in existing projects and the development of new projects, all upstream from the head of the Delta, is not known to the Commission. The areas in which this expansion is contemplated, including full development of the Boghra Bench, are climatically so located that it is the general practice therein to produce two crops annually. The great advantage of these lands over lands in the Delta is the fact that these lands can be summer cropped because they are out of the range of the "wind of 120 days." Since the limiting acreage has not been determined, it follows that the aggregate increase in stream depletion due to this expansion cannot be calculated at this time.

184. As has been previously noted, the capacity of the Kajakai Reservoir which it is assumed may be allocated to conservation storage is sufficient to provide a regulated yield within the pattern of irrigation requirements of approximately 2,000,000 acre feet out of the irregular inflow which enters the reservoir. This storage capacity, provided at the expense of Afghanistan, will undoubtedly be first used to regulate and control the releases as required for the development in Afghanistan.

185. When the full expansion in upstream development has been reached, return flow from the lower portion of the river immediately upstream from Band-i-Kamal Khan will provide a fair portion of the requirements for irrigation in the Delta. Return flow in small quantity, plus spills of flood water from the Arghandab Dam, will add to these return flows from the main river. Practically all of this water will fit within the pattern of irrigation requirements in the Delta. Thus in normal years of runoff no difficulty in water supply should be experienced in the Delta, provided that during the months of established maximum water requirements in the Delta (see Tables 8 through 11) the rate of storage at Kajakai Dam does not curtail the normal flow below the dam to less than the volume necessary to meet these established uses. Obviously, in years of subnormal runoff such as 1947, critical shortages may develop and general rationing of water may be required.

186. If the gaging stations proposed in this report are established immediately, it will be possible to accumulate in the next few years sufficient stream-flow data to determine the annual inflow to the Delta. During the same time experience in the operation of Kajakai Dam can be obtained to point the way to a method of operation which will provide the most beneficial regulation.

187. The only development in irrigation on the Arghandab River now in progress or contemplated, so far as known to the

Commission, is the construction of a dam and the creation of a reservoir shortly upstream from Kandahar. This reservoir will provide a better regulated flow for the existing irrigated acreage in the vicinity of Kandahar. The effect of this reservoir on the flow of the Helmand River will be negligible. Due to this regulation there will be a reduction in the passage of flood waters, which should be of benefit in the Delta, and there may be some return flow entering the Helmand River during those months when in the past the Arghandab River has been dry near its mouth.

188. While power production at the Kajakai Dam is not visualized at this time, provision is being made in the construction of the dam for the subsequent generation of energy at such time as it may be feasible. No details are available as to the rate at which power may be generated nor what the total kilowatt output might be.

189. Since the demand for power, whenever it is developed, will probably be more or less uniform throughout the year, while the irrigation demand varies from less than 1 percent in the month of September to 23 percent in March in the Delta, it can readily be seen that the two demands do not necessarily dovetail with each other. If power is to be produced, it will be necessary to make releases from stored water for this purpose during a certain period of the year. The result, so far as the lower river is concerned,

would undoubtedly be beneficial. Thus the production of electrical energy at the Kajakai Dam should be helpful to all of the lower river.

CHAPTER X

Conclusions

190. The studies made by the Commission and as described in detail in the foregoing report bring out a number of significant facts. Based on these facts the following general conclusions have been reached.

Agriculture

191. The basic crops in the Delta are the winter cereals, wheat and barley, which are planted in the autumn and harvested in the spring. Severe climatic conditions which prevail throughout the summer months probably preclude any appreciable shift from these basic crops to a summer economy. A better regulated water supply to assure full deliveries to all lands planted to these crops throughout the irrigating season will improve the production greatly. Shortages experienced in the past, except in years of extreme drought, have heretofore resulted from poor diversions of water from the main channels of the Delta rather than from a short supply. A little cooperation on both sides of the boundary could have alleviated this situation in practically every case.

Water Supply in the Delta

192. The annual water supply that has traditionally reached the Delta has always far exceeded the requirements for all beneficial purposes.

193. Present development upstream has not depleted the water supply below traditional inflow to the Delta.

194. Presently proposed works will deplete the flood flow, but the regulation of the residual flow through upstream storage will make a larger supply of low-water flow available to the Delta within the distribution required by irrigation.

195. The lowest total runoff for the most severe drought year at the head of the Delta, so far as historical information is available, was considerably more than one million acre feet. This is about twice as much water as was ever needed for actual irrigation. If properly regulated, the shortages in traditional uses in the Delta in the future will probably not be as severe, even after the expansion now contemplated upstream is completed. Four severe droughts have occurred within the period for which information is available, indicating an average frequency of once in 28 years. It must be anticipated that such droughts will probably also occur in the future. Critical shortages, beyond the means of reservoirs to prevent, may be experienced again, at which time the lakes will probably shrink to small size temporarily as in the past.

196. Floods have probably caused more damage in the Delta in the past than was ever caused by droughts. The most severe flood within the past century, which occurred in 1885, was exceptional and it is not anticipated that similar floods will be repeated very often. Most of the flood water of the past has escaped to the lakes unused. Developments in progress will tend to reduce the ordinary floods, converting a much larger proportion of the total flow to a rate of discharge that will fit within the pattern of irrigation requirements. However severe floods, when they occur, will damage the Delta in the future just as they have in the past. Provision for passing these severe floods through the Delta with a minimum of damage will of necessity have to be considered in all plans for the future.

Traditional and Present Water Requirements

197. Traditional acreage irrigated in the Delta is indicated to average 190,000 acres, of which 149,000 acres are in Seistan and 41,000 acres are in Chakhansur. Annual diversions to supply the full water requirements for the irrigation of these lands have been estimated to be:

For Seistan	530,000 acre feet
For Chakhansur	160,000 acre feet
Total	690,000 acre feet

198. Present water requirements, including an ample allowance for domestic use and stock water and distributed according

to a slight shift in acreage between the two countries, are estimated to be as follows:

For Seistan	556,000 acre feet
For Chakhansur	143,000 acre feet
Total	699,000 acre feet

199. Upstream uses on the river, by reason of their location, have in the past been served before any downstream uses were supplied. In the light of proposed upstream development it is believed that the best interests of both countries will be served if these established uses be given priority over any new uses developed after 1950. This priority should of course be subject to proportionate reduction in those years when the total flow of the Helmand River is below normal.

New Hydraulic Works in the Delta

200. The Miankangi Dam being built on the Rud-i-Seistan has been so designed by Iranian engineers that high gates may be installed to permit a raise in water surface sufficient to divert a part of the low flow into Common River. However present plans contemplate the installation of only low gates. Should these higher gates be installed now they will provide the control necessary to proportion the low flow between the Rud-i-Seistan and the Common River (Rud-i-Pariun). It appears that the problem of diverting a portion of the low-river flow into the Common River

during the next few years could be handled most economically by this method. This proposal is of importance to both countries, since by maintaining a flow in the Common River channel the lands irrigated in the Miankangi tract and the lands irrigated in Chakhansur north of Kohak can be served, and a pilot channel can be kept open during the summer months to take its share of flood flows when high water occurs in the spring of the year.

201. Other major works in either Seistan or Chakhansur should be preceded by adequate ground mapping and soil surveys to determine the best lands and the most economical means of using the available water supply.

New Hydraulic Works on the Upper Helmand River

202. Kajakai Dam, when completed, will result in a more scientific distribution of available water. It will do much to convert the irregular flows of the past to regulated flows which can be used for irrigation. This dam should be so operated that the traditional uses in the Delta during the winter months need not be curtailed. Officials in Afghanistan pointed out to the Commission that only flood water is to be stored in this reservoir. Storage of flood flows in excess of existing downstream requirements will permit the expansion of upstream development without in any way interfering with the cultural practice in the Delta. As more development takes place upstream, there will naturally

be more return flow that will reach the Delta during the period of normal low water.

203. The operation of the Arghandab Dam will not adversely affect the flow of water to the Delta.

204. The Boghra Canal project can readily be developed without detriment to the traditional irrigation in the Delta, after the regulation of river flow becomes effective at Kajakai Reservoir. Gradual development of the Boghra lands may proceed in advance of the completion of the Kajakai Dam without interfering with established irrigation uses downstream, provided the diversions for new Boghra lands are made from the river only when ample flow is available for both uses.

CHAPTER XI

Proposed Engineering Basis for Mutual Accord

205. In the discussions by the negotiators leading to a mutual accord between the two countries, it should be recognized that the developments in progress or now planned, if properly operated, will bring substantial benefits to each country.

206. The lack of any firm understanding in the past, and the meager technical information available as to the quantities of river flow which can be depended upon in the lower Helmand River preclude the immediate definition of a workable agreement for the future that can be expected to stand. It is therefore suggested that an initial mutual accord be established between the two countries on the basis of a joint understanding as to the traditional water requirements in their respective areas, such initial accord to run for a period of not less than 5 years. This initial accord may then be reviewed and reconsidered when the major storage reservoir now under construction on the upper Helmand River has been completed and some experience in its operation has been obtained. With the additional stream-flow records that will become available in the interim, it will be possible to make

a more reliable estimate of the annual water supply and how it will reach the Delta. The mutual accord could then be revised on a more sound engineering basis. Some flexibility will still be required in this revised accord, since it must be recognized that the experiences of succeeding years with the Kajakai Reservoir in operation will materially change the present regimen of the Helmand River in the Delta due to its capture of ordinary flood flows and the increase of return flows from the new acreage that will in all probability be gradually developed along the main stream.

207. In the initial accord the following points are suggested by the Commission for consideration:

208. The traditional beneficial uses which have been established in Seistan and Chakhansur should be recognized and agreement should be reached that in normal years the monthly requirements now established will not be depleted by new upstream uses. It should also be recognized that if a basin-wide drought occurs, water will be in short supply throughout the basin and a dry river bed may be experienced in the Delta.

209. An international gaging station on the Helmand River some 5 to 10 miles upstream from Kohak and above the backwater effects of the Miankangi Dam should be established, and another international gaging station should likewise be established on the Common River below Kohak. These stations should be jointly operated and jointly maintained with the provision that

discharge measurements can be made at any time by technical personnel from either country.

210. Afghanistan should continue its present stream-gaging program on the Helmand River and should install the additional gaging stations proposed in this report in order to provide adequate scientific information pertaining to the changing regimen of the river.

211. The development of the lands on the Boghra Bench should not exceed the planned rate until operation of Kajakai Reservoir becomes effective. No ill effects should be experienced in the Delta, provided net diversions to the Boghra project do not deplete the downstream flow to the Delta below the traditional and present day requirements in normal years. Harmony may be reached on this point if water is diverted to the Boghra lands only when sufficient flow is available in the river for both uses. Such a voluntary restriction on Afghan use of water upstream should be only temporary and should be waived when effective operation of Kajakai Reservoir has been initiated.

212. The rate of storage in the Kajakai Reservoir should be so limited that the required normal flows to maintain the existing uses in the Delta are not depleted. This restriction is in accordance with the assurance of Afghan officials to the Commission that it is planned to store only flood water and not to deplete the

normal flow below the amount required to maintain the established irrigation in the Delta.

213. In the light of this Afghan assurance, Iran might very well in the spirit of cooperation complete the gates of the Miankangi Dam which it is understood have been designed for such height that low-water flow may be proportionately distributed into the Rud-i-Seistan and the Common River. Iran and Afghanistan both will benefit greatly by these high gates since partial diversion of medium and low flows into the Common River channel will relieve serious scouring of the bed of the Rud-i-Seistan and will keep the Common River channel and the Pariun-Niatak sufficiently open to permit the passage of flood flows.

214. The water measured at Kohak in periods of low flow while uncontrolled river conditions still prevail should be diverted to Afghan and Iranian users in accordance with the traditional requirements.

215. Expansion in irrigation development in the Delta in either country should be permitted to proceed wherever nonbeneficial uses are converted to beneficial uses through improvement in the irrigation system and within the limits of the traditional water requirements.

216. In the later review and revision of the initial accord the following points are suggested by the Commission for consideration:

217. Both countries should continue to recognize the initial accord previously reached regarding the quantities of water which have been traditionally used in the Delta for beneficial purposes.

218. At least 5 years of additional stream-flow records will have become available to provide better information of the relationship between runoff in the upper river and the water that reaches the Delta. Revised estimates can then be prepared of the normal water supply which reached the Delta of the Helmand River under uncontrolled river conditions.

219. The rate of storage in the Kajakai Reservoir should be regulated so that the flow downstream will not be reduced below the inflow to the reservoir when that inflow is only sufficient for the maintenance of the established requirements downstream.

220. Negotiations could then proceed for the water required for expansion in Seistan as may appear feasible, based on the longer record of stream flow.

CHAPTER XII

Recommendations

221. As a result of the studies of the problem that have been earnestly carried out and in the light of the conclusions that have been reached, the Commission recommends that immediate attention be given to the following considerations:

The negotiation body to represent each of the two countries should be limited to not more than three members. At least one member from each country should be an engineer and all members should be thoroughly conversant with the problem and well acquainted with the Delta in their own country.

This report should be carefully studied by the negotiators and their governing bodies prior to formal discussions.

Iran should give attention at once to the placing of higher gates in Miankangi Dam.

Any consideration of an international diversion dam above Kohak should await the experience to be gained in the operation of the Miankangi Dam.

Afghanistan should proceed cautiously with the development of Boghra lands, until a regulated supply of water is made available through the operation of Kajakai Dam.

Improvements in irrigation methods in the Delta should proceed as rapidly as possible to diminish the present useless wastes.

Expansion in the irrigation in the Delta, other than due to the above improvements, should be deferred until the effects of Kajakai Reservoir on the river flow become known.

Gaging stations should be established at once as enumerated below:

By Afghanistan

Helmand River, at head of Kajakai Reservoir

By Afghanistan and Iran, jointly

Helmand River above Kohak

Common River below Kohak

Gaging stations previously established at the following points should be continued:

Helmand River at Kajakai Dam

Helmand River at Chaharburjak

Arghandab River at Kala-Bist

Each country should keep the discharge data up to date for all gaging stations within the basin in its own territory. The discharge data for the international gaging stations

should be so prepared as to result in a record mutually acceptable to both countries.

Jacques Dominique

Robert L. Lowry

Christopher E. Webb

APPENDIX I

The Sistan Arbitration

GENERAL SUMMARY AND ARBITRAL OPINION DATED TEHRAN, THE 19TH OF AUGUST, 1872 [1]

"I now proceed to summarise my views on the whole Sistan question, ..."

Summary

I. "Sistan was undoubtedly in ancient times part of Persia, and it appears to have been so especially under the Safavian kings; but under Ahmad Shah it formed part of the Durani Empire. Further it had not been recovered to Persia until at a very recent date; and that only partially, and under circumstances the nature of which materially affect the present inquiry."

II. "Ancient associations, together with the religion, language, and perhaps habits of the people of Sistan Proper, render the annexation of that tract to Persia by no means a strange or unnatural measure. But Persia has no valid claim to possess it on abstract right, whether the country be taken from Afghanistan, or whether it be simply deprived of independence. The period referred to for former connection is too remote. A century of disconnection cannot fail to be a bar to validity."

III. "The possession of the Afghans for the second half-century may have been more nominal than real, and more spasmodic than sustained. It may have been asserted by raids and invasions, or mere temporary tenure; but it has nevertheless a certain number of facts in support; and these are most material in an enquiry of this nature. General principles and theories are always important, but they cannot produce facts: whereas facts have a more practical tendency—for they support and establish general principles and theories. Neither ancient associations nor national sympathy are strong enough to nullify the force of circumstances, and circumstances show that Persia has exercised no interference in the internal ad-

[1] Excerpt from "The Report of Major General Goldsmid." Reference: *Eastern Persia*, by Sir Frederic John Goldsmid.

ministration of Sistan from the days of Nadir Shah until a very recent date."

IV. "Geographically, Sistan is clearly part of Afghanistan, and the intrusion of Kain into that province is prejudicial to the delineation of a good natural frontier.

It has been commonly considered part of Herat and Lash Juwain; though its dependence on the Helmand for irrigation may cause it to be included by some in the general valley of that river. The Neh Bandan Hills manifestly separate Sistan from Persia. I cannot but believe such would have been found to be the status had an illustrative map accompanied the sixth article of the Paris treaty."

V. "But while, in my opinion, Afghanistan has the advantage in claims on the score of an intermediate tenure, superseding that of Nadir Shah or the Safavian kings, it cannot be denied that from year to year she has been relaxing her hold over Sistan; and this has been evinced in a marked manner since the death of the Wazer Yor Muhammad. It would be absurd to contend that the second half-century of Afghan connection with the province has been a period of continuous possession. That Sistan has now fallen into the hands of the Amir of Kain can only be attributed to the helplessness of its independence and the personal action of its ruler. It was for a time at least out of the hands of Afghanistan. I do not admit that the manner in which Sistan was occupied by Persian troops corresponds with an appeal to arms such as contemplated by Lord Russell's letter quoted. There was no fair fighting at all. Nor can it be admitted that allegiance was obtained by the single means of military movements or open procedure of any kind. On the other hand, I cannot (see) that the Afghans took any measures to counteract the proceedings of Persia, when treating with Ali Kahn, Taf Muhammad, or other Sistan chiefs."

VI. "As the Sistan of the present day is not the separate principality of the past, and it is essential to a due appreciation of claims that the parts in possession of either side should be intelligibly defined, I revert to a territorial division which has appeared to me convenient and approximate. By this arrangement the rich tract of country, which the Hamun on three of its sides and the Helmand on the fourth cause to resemble an island, is designated 'Sistan Proper', whereas the district of Chakhansur and lands of the Helmand above the Band, and Sistan desert, are known as 'Outer Sistan.'

The first may be considered in absolute possession of Persia, and has a comparatively large and mixed population.

The second is either without population or inhabited chiefly by Baluchis, some of whom acknowledge Persian, some Afghan sovereignty. The professions of Kamal Khan and Imam Khan do not to my mind prove a possession to Persia, similar to that of Sistan Proper. Chakhansur on the right bank of the Helmand is under

the Afghans. But the fort of Nad Ali on the same bank has been lately taken by the Persians.

VII. I have to consider ancient right and present possession, and report briefly my opinion on both these heads: 1st. That Sistan was incorporated in the Persia of ancient days: but the Afghanistan of Ahmad Shah, which also comprised Sistan, had not then come into existence; and it is impossible to set aside the fact that this kingdom did exist, any more than that Ahmad Shah was an independent monarch. 2nd. That the possession of Sistan obtained in recent days by Persia cannot affect the question of right as regards Afghanistan. If admitted at all under the circumstances, it can only be so subject to certain restrictions, and with reference to the particular people brought under control.

Arbitral Opinion

Weighing therefore the merits of the case on either side as gathered from evidence of many kinds, and with especial regard to the great advantages of a clearly defined frontier, I submit an opinion that the tract which I have called 'Sistan Proper' should be hereafter included by a special boundary line within the limits of Persia, to be restored to independence under Persian protection, or governed by duly appointed governors. This opinion is accompanied by an expression of the sincere and earnest hope that the Persian rule will prove beneficial to a people whose nominal state has been from time immemorial one of terror, suspense, and suffering.

But I am thoroughly convinced that, by all rules of justice and equity, if Persia be allowed to hold possession of a country which has fallen to her control under such circumstances as these detailed, her possession should be circumscribed to the limits of her actual possession in Sistan Proper, as far as consistent with geographical and political requirements. She should not possess land on the right bank of the Helmand.

If in a question of ancient right and present possession, a military occupation of six or seven years and the previous action of a local chief be suffered to outweigh rights and associations extending more or less over a whole country, and Arbitration award the most coveted, populous, and richer part of the Sistan province, it is manifestly fair that some compensating benefit should accrue to the losing side.

It appears therefore beyond doubt indispensable that Nad Ali should be evacuated by Persian garrisons, and both banks of the Helmand above the Kohak Band be given up to Afghanistan. And this arrangement becomes doubly just and proper when the character of the inhabitants along the banks of the river is compared with that of the Sistanis of Sekula, Deshtak, and Sistan Proper.

The main bed of the Helmand therefore below Kohak should be

the eastern boundary of Persian Sistan, and the line of frontier from Kohak to the hills south of the Sistan desert should be so drawn as to include within the Afghan limits all cultivation on the banks of the river from the Band upwards.

The Malik Siah Koh, on the chain of hills separating the Sistan from the Karman desert, appears a fitting point.

North of Sistan the southern limit of the Naizar [1] should be the frontier toward Lash Juwain. Persia should not cross the Hamun in that direction. A line drawn from the Naizar to the 'Kuh Siah' (black hill) near Bandan would clearly define her possessions.

It is moreover to be well understood that no works are to be carried out on either side calculated to interfere with the requisite supply of water for irrigation on the banks of the Helmand."

F. J. GOLDSMID, *Major-General, on Special Mission*

"Postscript. A Map, showing the boundaries claimed as well as those of Possession, has been prepared to lay before the final meeting. . . ."

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[1] Apparently interpreted—broad bed of reeds.

APPENDIX II

Arbitral Award on the Seistan Water Question, Dated at Camp Kuhak on the 10th April 1905, by Colonel A. H. McMahon, C.S.I., C.I.E., British Commissioner, Seistan Arbitration Commission[1]

Preliminary Remarks

Paragraph 1.—General Sir Frederick Goldsmid, as Arbitrator between Persia and Afghanistan, was called upon to settle the question of rights to land and water of Persia and Afghanistan in Seistan. He delivered an arbitral award on both points in 1872, which was confirmed by Her Majesty's Secretary of State for Foreign Affairs and accepted by the Persian and Afghan Governments in 1873.

2. At the time of the above award the Helmand river had one main distributary channel in Seistan, i.e., the Rud-i-Seistan, at the mouth of which, in order to divert sufficient water into this Rud, was a tamarisk *band* known as the Band-i-Kohak or Band-i-Seistan. The Helmand river from thence onwards flowed in one channel past Nad Ali and along what is now known as the Sikhsar into the Naizar and Hamun. In 1896 a large flood caused the river to burst out for itself a new main channel, which left the old one near Shahgul and is now known as the Rud-i-Parian.

3. Various disputes regarding water between Persian and Afghan Seistan, which were caused by changes in the course of canals and in the course of the main river, have arisen since 1872. My enquiries show that these have, until recently, always been mutually and amicably settled by the responsible officials concerned on both sides, i.e., the Governors of Seistan and Chakhansur. These officials, who thoroughly understood each other's water requirements, have always shown great tact and skill in settling water disputes to the mutual satisfaction of both countries.

4. Unfortunately of recent years, whatever may have been the cause, and whether this was due to the changes in the course of the main stream, or to more strained relations, the amicable settle-

[1] From "Report of the Perso-Afghan Arbitration Commission 1902–1905."

ment of water difficulties has been found to be no longer possible. A series of small, and in themselves unimportant, water questions arose between 1900 and 1902, which, by reason of estranged relations, caused mutual misunderstanding and increased ill-feeling, until matters were brought to a crisis by further disputes arising from abnormal deficiency of water in the Helmand in 1902. This led to the present reference to the arbitration of the British Government.

5. The condition under which the present arbitration has been agreed to by the Governments of Persia and Afghanistan is that the award should be in accordance with the terms of Sir Frederick Goldsmid's award.

6. In framing my award I am, therefore, restricted by the above condition.

7. Sir Frederick Goldsmid's award on the water question was as follows:—"It is clearly understood that no works are to be carried out on either side calculated to interfere with the requisite supply of irrigation on both banks of the Helmand." Her Majesty's Secretary of State for Foreign Affairs, in his capacity as the final confirming authority of that award, further laid down in 1873, after consulting General Goldsmid, that the above clause should not be understood to apply either to existing canals, or to old or disused canals that it may be desired to put in proper repair, nor would it interfere with the excavation of new canals, provided that the requisite supply on both banks is not diminished.

8. The above award is so definite that it is unnecessary to make any attempt to define it further, except on one particular point. This award provides that Persia has a right to a requisite supply of water for irrigation. In order to prevent future misunderstandings, it only remains to define what amount of water fairly represents a requisite supply for Persian requirements.

9. From the careful and exhaustive measurements, observations, and enquiries made by this Mission in Seistan, the following facts have been clearly established:—

(*a*) Seistan suffers more from excess than deficiency of water. Far more loss is caused by damage done to land and crops year after year, by floods, than is caused by want of water for irrigation.

(*b*) In only very few exceptional abnormal years of low river has any question of sufficiency of water arisen in Seistan, and then Afghan Seistan has suffered equally with Persian Seistan. Moreover, questions as to the sufficiency of water only prove serious when the spring crop cultivation is concerned, when the river is at its lowest, i.e., between the autumn and spring equinoxes, yet it has been ascertained that in only 3 out of the past 35 years has there been any serious deficiency of water in Seistan during that season. It is necessary,

therefore, first to consider water requirements during the season of spring crops. Any settlement based on the requirements of that season will meet the case of the remainder of the year also.

(c) After carefully calculating the normal volume of the Helmand river during the period between the autumn equinox and the spring equinox, it has been clearly ascertained that one-third of the water which now reaches Seistan at Bandar-i-Kamal Khan would amply suffice for the proper irrigation of existing cultivation in Persian Seistan, and also allow of a large future extension of that cultivation. This would leave a requisite supply for all Afghan requirements.

10. I therefore give the following award:—

Award

Clause I.—No irrigation works are to be carried out on either side calculated to interfere with the requisite supply of water for irrigation on both banks of the river, but both sides have the right, within their own territories, to maintain existing canals, to open out old or disused canals, and to make new canals, from the Helmand river, provided that the supply of water requisite for irrigation on both sides is not diminished.

Clause II.—The amount of water requisite for irrigation of Persian lands irrigable from and below the Band-i-Kohak is one-third of the whole volume of the Helmand river which enters Seistan.

Seistan, to which Sir Frederick Goldsmid's award applies, comprises all lands on both banks of the Helmand from Bandar-i-Kamal Khan downwards.

Clause III.—Persia is, therefore, entitled to one-third of the whole Helmand river calculated at the point where water is first taken off from it to irrigate lands on either bank situated at or below Bandar-i-Kamal Khan.

Clause IV.—Any irrigation works constructed by Afghanistan to divert water into Seistan lands, as above defined, must allow of at least one-third of the volume of the whole river being available for Persian use at Band-i-Kohak.

Clause V.—To enable both sides to satisfy themselves that this award is being complied with, and at the same time to avoid the necessity of fresh references to the British Government and the expense of special Missions, a British officer of irrigation experience shall be permanently attached to the British Consulate in Seistan. He will be empowered to give an opinion, when required by either party, on any case of doubt or dispute over water questions that may arise. He will, when necessary, take steps to bring the real facts of any case to the notice of the Government concerned. He will be able also to call the attention of either party to any important indi-

cations of threatening danger to their water supply arising from natural causes or their own irrigation works. To enable this officer properly to fulfil the functions of his office, free access shall be given to him by either side to the Helmand river and its branches and the heads of canals leading therefrom.

Clause VI.—The maintenance of the Band-i-Kohak is of great importance to the welfare of Persian Seistan. It is possible that the deepening of the river bed at and below the site of the present band may necessitate moving the band a short distance further up the river. Afghanistan should allow Persia to move this band, if necessary, and grant Persia the right to excavate the short canal required for such new band through Afghan territory to the Rud-i-Seistan.

Similarly, should it become necessary for Afghanistan to move the present Shahgul band across the Rud-i-Parian somewhat lower down the stream, Persia should (as has been done before) allow Afghanistan right of way for a canal through Persian territory from that band to the Nad Ali channel.

Clause VII.—It will be noted that the rights to the Helmand river, which her geographical position naturally gives to Afghanistan as owner of the upper Helmand, have been restricted to the extent stated above in favour of Persia in accordance with Sir Frederik Goldsmid's award. It follows, therefore, that Persia has no right to alienate to any other Power the water-rights thus acquired without the consent of Afghanistan.

Clause VIII.—I cannot close this award without a word of warning to both countries concerned. The past history of the Helmand river in Seistan shows that it has always been subject to sudden and important changes in its course which have from time to time diverted the whole river into a new channel and rendered useless all the then existing canal systems. Such changes are liable to occur in the future, and great care should, therefore, be exercised in the opening out of new canals, or the enlargement of old canals leading from the Helmand. Unless this is done with proper precaution, it may cause the river to divert itself entirely at such points and cause great loss to both countries. This danger applies equally to Afghanistan and Persia.

APPENDIX III

Official Letter from Dr. Khochbine

September 14, 1950

MR. MALCOLM H. JONES, *Engineer-Secretary*
The Helmand River Delta Commission
Room 2279
New State Department Building
21st Street and Virginia Avenue
Washington, D. C.

DEAR MR. JONES:

Mr. Tashakkori and I have just completed, with the assistance of our advisers, a study of all the material available to us bearing upon the question of apportionment of the waters of the Hirmand River. It is the plan of my Government to give copies of this report, as soon as it is printed, to you and to the members of the Commission. It is my hope that it will be ready in a very short time.

There is one matter that our studies have revealed which I feel should be brought to your attention without further delay.

The available data establishes, we believe, that the traditional requirements of Iran are not less than the following:

Throughout	
January	3,420 cusecs
February	4,620
March	8,640
April	4,710
May	1,480
June	2,770
July	2,230
August	1,240
September	1,190
October	2,060
November	2,520
December	2,670

Based upon the findings of the McMahon Mission, we have calculated that the comparable requirements in Afghanistan at the time

when Iran was using the foregoing quantities of water were not more than 54% of those amounts. That is, in months when the full supply of the river was put to beneficial use, the Afghan use was not more than 35% of the total supply and the Iranian use at least 65%.

As we understand the principle of equitable apportionment, the amounts set out above and the amounts that are determined as representing the properly established uses in Afghanistan at the time of the McMahon investigations enjoy rights prior to any subsequent uses. If and when there is an excess above those amounts, they should be allocated taking into account a variety of considerations, including uses properly established (without cutting into the share of the other side) since that time. The determination of the full supplies and the apportionment of any excess above those supplies already properly appropriated at the time of McMahon is one of the matters you have investigated and that the Commission will study.

Of course, there may be years, particularly before the storage dams are utilized, when the total supply of the Hirmand may not reach the total of the senior allocations to Afghanistan and Iran. We understand that under the principle of equitable apportionment the uses that are junior must ration what is left after meeting the full requirements of the uses that are senior. Contrary to this principle, there are indications that the Afghan Government may take the position that being upstream, it is entitled to take out of a deficient total supply its full allocation and leave to Iran what is left. We, of course, cannot accept that view, but we are disposed in the interests of simplicity and of a practical working solution to accept a formula for reduction that assumes that all of the uses at the time of the McMahon investigations that took the supplies set out in the figures above are of equal antiquity, and accordingly, in years of scarce supply, those allocations should be reduced proportionately and to the extent that a joint commission would find to be necessary.

I mention the foregoing to you now in order that the figures that were given to you in Teheran may be understood in their proper context. You asked for a calculation of the supplies required to meet existing agriculture in Seistan. The figures given to you undertake to give this information. It must be borne in mind, however, that these figures are based upon the agriculture existing in the period around 1936–1942 when the supplies reaching Seistan had already been reduced below the appropriations enjoyed traditionally by Iran.

The art of irrigation has improved with the years, and while progress generally in the Middle East may not have kept pace with some other parts of the world, there has been a considerable raising in the duty since the time of the McMahon investigations. This has been assisted greatly by the increase in Seistan of private ownership of the farms. The effect of such an increase in the duty

should have been to permit Seistan to increase its culturable acreage with its traditional supply. By reason of increased Afghan withdrawals upstream, the result of the increased efficiency in the use of such supplies as have reached Seistan has been that Seistan has not been able to enjoy the increase in acreage that was cultivated at the time of McMahon to which the increased efficiency entitled it. This assumes at least a normal supply. In the dry years the acreage has been comparably less. This is the reason why the figures were given to you in two sets showing the water required to maintain with the presently increased efficiency the reduced acreage that has been in recent times cultivated in dry years as well as the acreage in normal years.

The figures given to you in Teheran, accordingly, do not show the amounts of water that represent the traditional requirements of Iran; rather, they show the amounts to which Iran had been reduced up to around 1936–1942. As you know there have been further reductions since and still other substantial reductions are threatened.

The foregoing will be set forth more fully in the study to which I have referred, but I wanted to get this information to you now so that it may be included with any information which you hand to the Commissioners.

Sincerely yours,

DR. GHOLAM-HOSSEINE KHOCHBINE

APPENDIX IV

Cultivation in Chakhansur

PRESENTED TO THE HELMAND RIVER DELTA COMMISSION BY H. E. MADJID KHAN ON NOVEMBER 5, 1950

1. During their study of cultivation and the quantity of water in Chakhansur, the honored commissioners have observed the ruins of the past civilization of this area, and the present plight of the people of this region, and must have noted that:

a. All these ruins, dried up canals, and abandoned villages are good testimonies of a once prosperous agricultural civilization which must have had its foundation upon resources of the Helmand River. The presence of all these ruins prove the right of the region of Chakhansur to the water from the Helmand, both in the ancient and also at the time of McMahon. It was because of the indications of the past civilization of this region and the abundance of ruins that, in spite of the development of the Iranian Seistan to 128–148 thousand acres (1903) and the developments in Chakhansur of between 24–28 thousand acres that McMahon in his decision awarded two portions of water to Afghanistan and only one portion to Iran.

b. Before 1939, when the bed of the river toward Rud-i-Seistan was high and the river was flowing its natural course, Chakhansur enjoyed not only extended autumn cultivation but had also appreciable summer crops, which included vast cultivation of cotton. The presence of a cotton ginning factory at Kang is a sign of prosperous cultivation of cotton in this region.

c. When the bed of Rud-i-Seistan was high, the Afghans were ever ready to cooperate with the Iranians in the construction of the Kohak Diversion. But ever since 1939, when because of floods the bed of Rud-i-Seistan has been washed low and the entrance to the Common River has been left high, the Iranians have not assisted us in the construction of the customary diversion at Kohak. Thus the bulk of the river flows to Iran and the agriculture on the Afghan side is on the decline. This situation has not only affected summer agriculture but has affected autumn cultivation also. Because of lack of water the land remains fallow and the farmers who lack other means of subsistence have to abandon their land for search of a livelihood elsewhere. From the available information, 6,000 families of farmers have migrated to other regions between 1947–1949. This migration brings other problems in its wake. With the

migration of the able-bodied farmers the problem of manpower, to the extent that it affects the digging of the canals that get filled with sand during the 120-day winds, becomes very acute. Hence the problem of the people, in digging the canals, is increasing as a result of such migrations. The honored commissioners who have studied the problem of the canal digging from close distance can easily realize that the entire welfare of Chakhansur is in danger.

d. Iranian Seistan has taken advantage of the circumstances and after the deepening of the bed of the Rud-i-Seistan, unlike the assistance that they were receiving from us prior to this situation, have not helped us to get our rightful share of the water. Even today, in spite of the agreement of the Iranian Government to the formation of a commission through the good offices of the Government of the U.S.A. to study this problem, they have undertaken unilateral action in expanding their efforts to utilize modern engineering facilities in aggravating the situation. This situation has caused great concern among the people of Afghanistan.

e. According to available information, even now the greater part of the water of Rud-i-Seistan flows into Hamun and gets wasted while the farmers of Chakhansur lack water for drinking for themselves and their animals, much less for their cultivation.

f. Still more important is the poverty and the destitution of the people of Chakhansur. The honored commissioners, we are sure, have seen the miserable plight of the people of this area who have been driven to the sorry state of affairs because of the shortage of water and the paucity of agriculture.

2. The data obtained from the gaging stations at Chaharburjak and Kohak and the measurement of water elsewhere on the lateral streams and the terrific loss from seepage and evaporation between the station where the water is divided and the station where water is taken is worthy of note and further consideration.

3. In order to distribute water between Iran and Afghanistan equitably we consider it necessary that possible gaging stations and other technical installations should be erected, so that both parties can easily take their rightful share without resorting to unreliable guess work.

4. It is evident that the Common River is so directly related to agriculture and the life of the people of this area that the installation or furtherance of any technical project by one party directly affects the life of the people of the other party. It was because of this fact that Afghanistan temporarily postponed the project for the improvement of irrigation in Chakhansur that she had on hand in 1935. But today that Iran has undertaken a vast project in Seistan, it is inevitable that the rights of the people of Chakhansur will be affected adversely. Hence if their program in the down-river area is not amended now, Afghanistan will be forced to protect the people of Chakhansur from further miseries by taking appropriate steps.

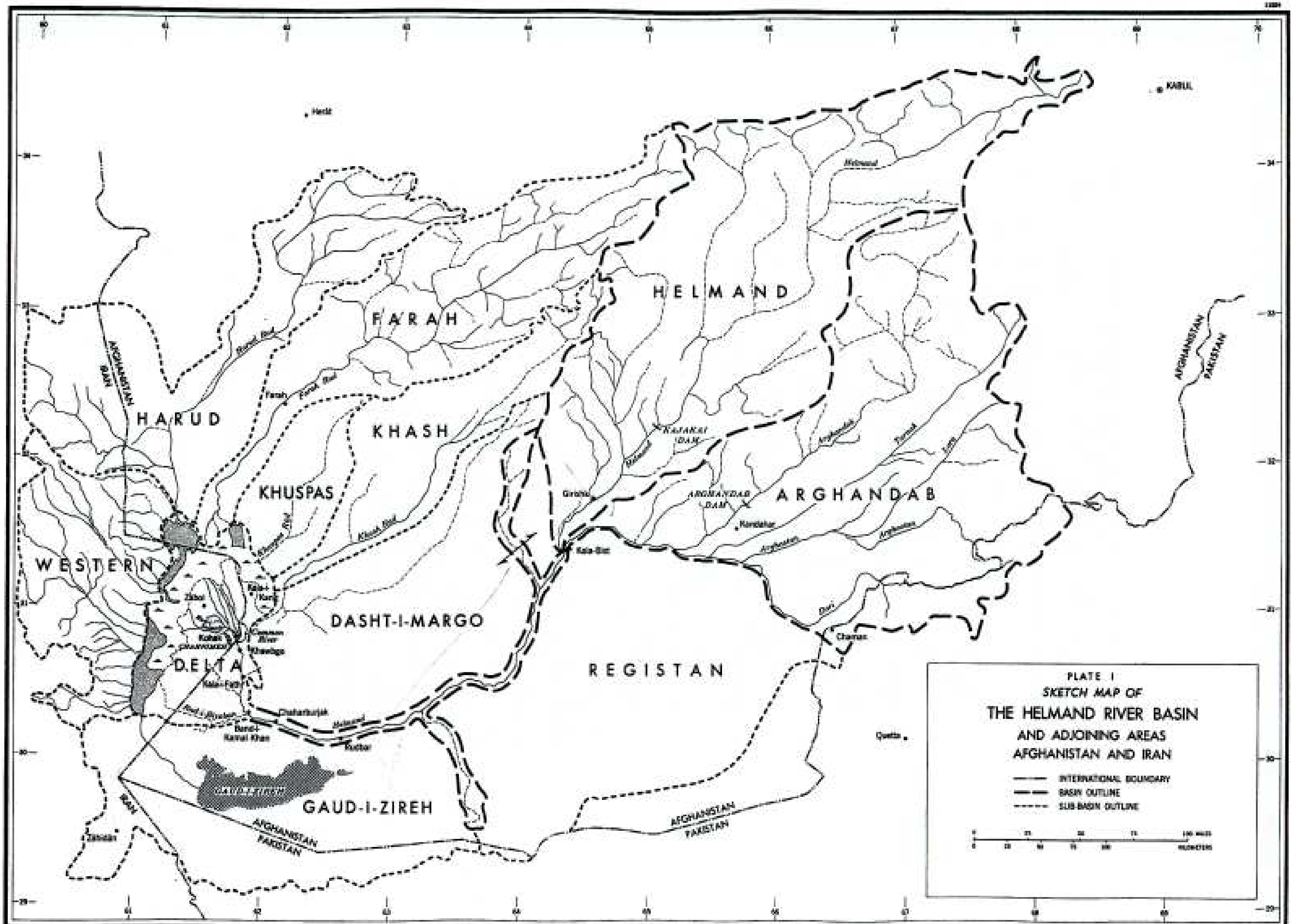
PLATE I
SKETCH MAP OF
THE HELMAND RIVER BASIN
AND ADJOINING AREAS
AFGHANISTAN AND IRAN
INTERNATIONAL BOUNDARY
BASIN OUTLINE
SUB-BASIN OUTLINE
HELMAND
ARGHANDAB
FARAH
HARUD
KHASH
KHUSPAS
WESTERN
DELTA
DASHT-I-MARGO
REGISTAN
GAUD-I-ZIREH
KAJAKAI DAM
ARGHANDAB DAM
Kandahar
Kala-Bist
Girishk
Chaman
Quetta
Herat
KABUL
Zabol
Chaharburjak
Rudbar
AFGHANISTAN
IRAN
PAKISTAN

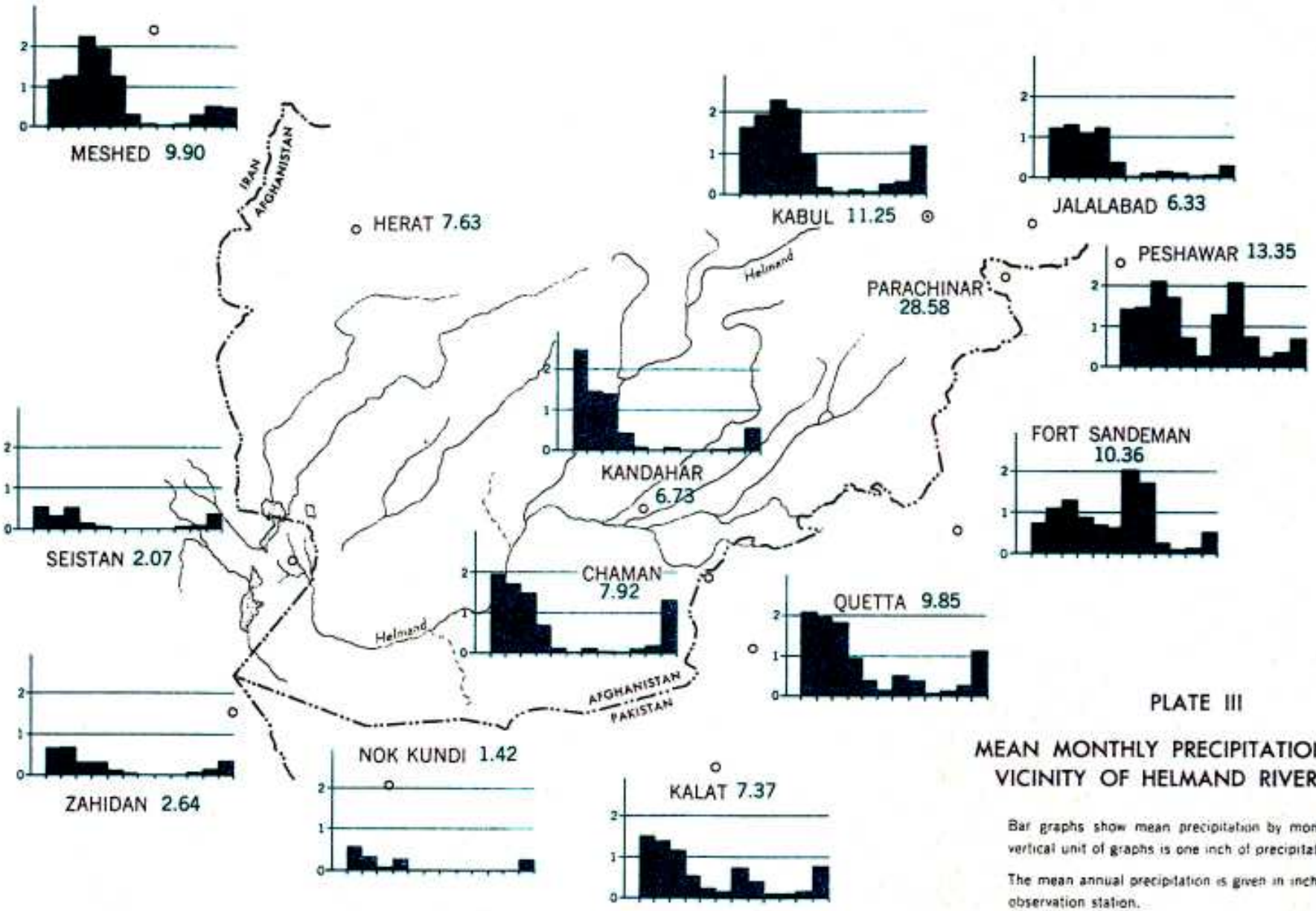

PLATE III

MEAN MONTHLY PRECIPITATION IN THE VICINITY OF HELMAND RIVER DELTA

Bar graphs show mean precipitation by months. Each vertical unit of graphs is one inch of precipitation.

The mean annual precipitation is given in inches at each observation station.

—·—·— INTERNATIONAL BOUNDARY

0 50 100 150 200 MILES

0 50 100 150 200 KILOMETERS