

IRRIGATION AND DRAINAGE IN THE WORLD

A GLOBAL REVIEW

VOLUME I

by

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AFGHANISTAN*

1. PHYSIOGRAPHY

Afghanistan is a variegated, land-locked country of high mountains and narrow fertile valleys and lies in the north temperate zone between 29° 30' and 38° 30' north latitudes and 60° 30' and 75° east longitudes. It is roughly a quadrangle in shape, 1,126 km long from north-east to south-west and 563 km wide generally. It is bounded on the west by Iran, on the north by the USSR, and on the east and south by Pakistan. The total area of the country is 647,500 km².

The dominant topographical feature of Afghanistan is the great mountain range of the Hindu Kush, which takes off from the Sarikol and Muztagh ranges in the glacial ranges of the Pamirs, and after running along the Pakistan-Afghanistan border crosses the country in a generally westerly direction, gradually diminishing in height till opposite Kabul, where the elevation of the main ridge varies from 457 to 610 m

To the south of the main range long spurs spread out fan-wise to the south-west, forming the watershed between the Helmand and the Indus basins and running out south-westward to the Registan in a series of nearly parallel ridges. North of the main ridge the valleys merge into the plateau of Badakhshan and Afghan Turkestan. The northern edge of this plateau forms in places a steep escarpment falling away to the valleys of the Oxus River (Amu-Darya), while in the west the prolongation of the escarpment becomes the subsidiary range of the Band-i-Turkestan separating the plateau from the sand formations of the Chul.

Round the bases of the Central range the four main divisions of the country correspond to the four principal river systems. In the north and north-east tributaries of the Oxus drain the northern slopes and pass through a series of gorges and deep precipitous valleys on to the plains of Badakhshan and Afghan-Turkestan. In the west the Hari Rud crosses the plain of Herat before turning north to lose itself in the sands of the Kara-kum desert. Not far from the headwaters of the Hari Rud, and close to the sources of the Kabul River, the Helmand River flows south-west through a series of deep gorges before debouching on to the plains a few miles north of the city of Kandahar. It continues south-west, and after being joined by the Arghandab crosses the Registan and disappears into the great swamp, the Hamun, on the Persian border. From the south-eastern slopes of the Hindu Kush, the Ghorband and the Panjshir join the Kabul River soon after it leaves the Kabul plateau through the great gorge of the Tangi Gharu. At a distance of 96 km further east, the Kabul River emerges on to the plain of Jalalabad and is joined by the Kunar and flows down through the frontier hills to meet the Indus River at Attock.

*Information updated in ICID (CIID) Central Office

2. CLIMATE AND RAINFALL

The climate of Afghanistan is predominantly continental, being arid to semiarid; its chief characteristics are extremes of temperature, both seasonal and diurnal, wind and dryness. Monsoon influence is occasionally present in Jalalabad to the east and Kandahar to the south-west and as far north as Kabul.

The range of daily temperatures, both in summer and winter, is quite wide throughout the country. In southern desert areas temperatures sometimes touch a high of 49°C during the day, but cool to 15.6°C at night. Winter temperatures in the northern deserts occasionally drop to -23.3°C at night, but rise to 10°C under the clear skies and warm sun.

Precipitation varies from year to year. No clear distribution exists between the rainy and dry seasons, as rainfall varies depending on the origin of moist air. It is not uncommon that 30 per cent, and sometimes up to 100 per cent, of the month's rainfall occurs within a period of 24 hours. It usually occurs in winter and spring from January through May. During the winter the Central Plateau frequently receives a metre or more of snow, while in the Hindu Kush region snow accumulation is considerably deeper. Average annual precipitation at some selected stations for the 10-year period (1964-1973) is: South Salong 1,098 mm; North Salong 1,034 mm; Kabul 335 mm; Jalalabad 203 mm; Baghlan 325 mm; Khost 411 mm; Kunduz 311 mm; Kandahar 119 mm; Herat 237 mm; Ghazni 318 mm; Maimana 358 mm; Mazar-i-Sharif 182 mm and Sheberghan 201 mm. Average annual precipitation over the Kabul basin is 450 mm and that over the Helmand basin is 250 mm.

Radiation inputs may be among the highest in the world in Afghanistan. A light intensity survey in the Helmand valley area (from 21 May 1973 to 5 November 1973 by Mathewson) showed maximum intensities exceeding 16,000 foot candles (f.c.) and average daily maxima between 13,000 and 15,000 f.c. The average duration over this period of over 4,000 f.c. intensity was 10.9 hours/day. This high rate of solar radiation has important implications for both agriculture and irrigation.

The climatic conditions of Afghanistan make successful cultivation of land primarily dependent on irrigation, particularly in the valleys north of the Hindu Kush, and the Kabul and the Helmand basins.

3. POPULATION AND SIZE OF HOLDINGS

The total estimated (FAO) population of Afghanistan in 1978 was 20.88 million out of which 16.42 million persons were dependent on agriculture in one form or the other. Out of a total economically active population of 7.04 million active population engaged in agriculture accounted for 78.6 per cent. The annual population growth rate is 2.4 per cent, but the annual food production rate is 1.5 per cent. The country lacks industrial infrastructure — it has no railroads and no heavy industry. Agriculture remains the mainstay of the economy both in terms of production and employment.

Although Afghanistan is considered to be an agricultural country with about 80 per cent of its population depending directly on agriculture, the ratio of acreage of agricultural land to the number of people deriving a living from farming is very low. Land belongs in part to owner-cultivators and in part to big landowners who, as a rule, rent it to peasants.

Individual agricultural plots are usually very small, seldom exceeding one hectare. A great number of farmers are landless or with an uneconomical holding of land.

Irrigated plots are divided into well-levelled strips of checks; flood irrigation is the rule, irrigation by furrows being limited. The periods of droughts induce land fragmentation through frequent mortgages and sales.

4. LAND RESOURCES

Of the total area of the country (64.75 million ha), some 8.05 million ha are arable under temporary and permanent crops, 50 million ha under permanent pastures, 1.9 million ha are forests and woodlands, and the rest (4.8 million ha) is either unused but potentially productive land or built-on area and wasteland.

There are two broad regions: (1) desert region comprising alluvial, desert sand, lithosols, serozems, solonets, etc., and (2) dry mediterranean mountains having alluvial, cinnamonic, lithosols, etc.

The bulk of agricultural soils lies in the valleys north of the Hindu Kush in the Kabul and the Helmand basins. Some of these lands are salt-affected due to the lack of drainage facilities, but on the whole the soils are fertile and yield good crops when irrigation facilities are provided.

5. WATER RESOURCES

SURFACE WATERS

The total surface water resources of Afghanistan are estimated at 50,000 million m³ (Table I). The two river systems, the Kabul and the

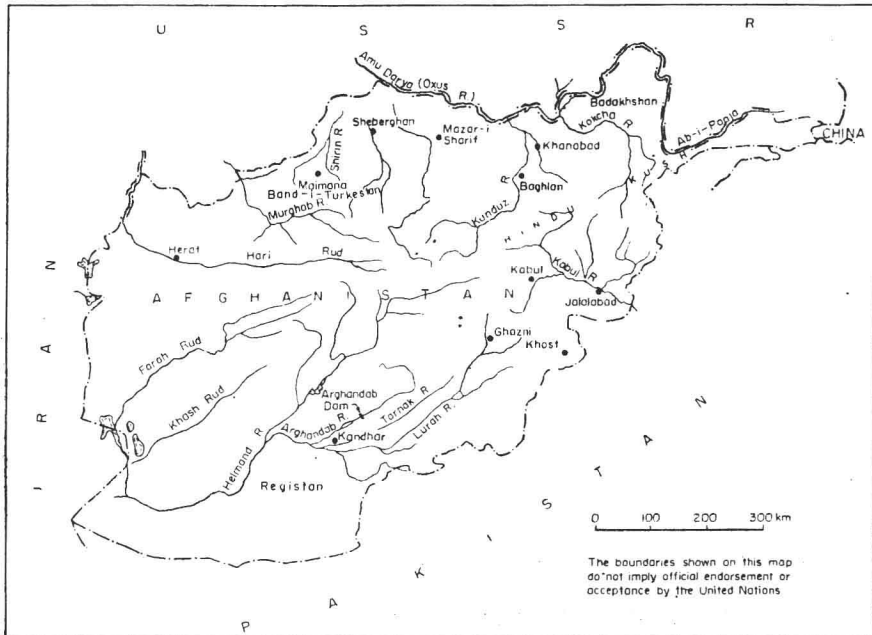


FIGURE 1 : Map of Afghanistan showing rivers

Helmand, constitute between them two-thirds of the total surface water resources within the Afghanistan territory of the Country. The specific discharge works out to 1.7 l/s/km^2 .

The Kabul River, a tributary of the Indus River, is 480 km long and has a total drainage area of $77,850 \text{ km}^2$, out of which an area of $66,235 \text{ km}^2$ lies in Afghanistan. The mean annual runoff over the basin, expressed in depth, is 317 mm, and the average annual runoff at Warsak (42 km down the border between Afghanistan and Pakistan), is 21,400 million m^3 . Except for places located at high altitudes, the climate of Kabul basin is extreme, being dry and intensely hot during summer and cold during winter.

TABLE I
SURFACE WATER RESOURCES OF AFGHANISTAN

River	Basin area (km^2)	Water potential (million m^3)
Ab-i-Panja	29,680	7,000
Kokcha	24,840	5,000
Kunduz	37,800	3,000
Bandihala, Khoulm	59,400	4,200
Ab-i-Kausar	17,400	1,200
Murghab	38,600	3,000
Hari Rud	36,000	2,600
West Reg'on	22,800	500
Harut	18,400	900
Farah Rud	30,800	2,000
Khash Rud	22,000	1,100
Khaspar Rud	19,180	500
Helmand	154,700	10,000
Kabul	52,000	8,000
Gumal	19,100	1,000
Deserts and other areas	67,300	nil
Total	650,000	50,000

The Helmand River is 1,050 km long and its system has a total catchment area of $370,000 \text{ km}^2$. (The United Nations estimated in 1978 the area of the Helmand basin at $386,000 \text{ km}^2$, out of which an area of $300,000 \text{ km}^2$ lies in Afghanistan). The total average annual runoff of the entire Helmand system is estimated around 11,600 million m^3 . The mean annual runoff of the whole basin expressed in depth is 32.4 mm,

GROUND WATERS

In respect of ground water, work is under way for making comprehensive ground-water investigations in the Kabul area and the Katawaz area south of Ghazni with the help of United Nations. The total area involved is about $26,300 \text{ km}^2$ and there appear to be potentialities of shallow ground-water pumping and artificial recharge schemes. Existence of talus at the foot of steep slopes and the texture of soils generally favour high infiltration rate and gives rise to the storage of the ground water, which is exploited through wells and Karez (Kanats) for irrigation and water supply.

6. BRIEF HISTORY OF IRRIGATION AND DRAINAGE

Though irrigation in Afghanistan, according to recent historical investigations, dates back to the third millenium, the history of use of water for irrigation in Afghanistan may be divided into three main periods.

The *first* (or pre islamic period) extends from the 6th Century B.C. to the 10th Century A.D., when Islam became established in that part of Central Asia. This period saw the western influence of the Persian Empire (Cyrius and Darius) and in the 4th and 3rd Century B.C. of the south-eastern Indian and south-western Greek (Alexander) civilizations. By the 2nd Century B.C. eastern Afghanistan had become an important Buddhist centre (Khanishka), which survived until the Iranian and Turkish incursions and hegemony in the 7th Century A.D. It is during this period that in the time of Alexander the earliest irrigation networks appear to have been constructed around the newly founded Alexandrias (Herat, Kandahar and Bakhtr).

The *second* period extends from the foundation of the Ghasnevid dynasty (of Turkish origin) by Mahmud of Ghazni in the 10th Century until 1747, the year marking the "National Awakening" and the formal establishment, by Ahmad Shah of the Durrani dynasty of Afghanistan as an independent sovereign State. Construction of stone and brick masonry diversions and storage dams have been practised for many generations and the ruins of some of these engineering works are still in evidence. The remains of four of these ancient dams, reputed to have been constructed by Sultan Mahmud of Ghazni (998-1030 A.D.), were taken over by the Government during the last decade and rebuilt into a project, now known as the Band-i-Siraj Project. This provides irrigation waters to an area of about 6,070 ha. It is probably under the Timurids (14-16th Century) that present main settlements were permanently established and that most of the famous *Karez* (or underground water conduits) were dug.

The *third* period extends from the founding of the Afghan Kingdom in 1747 until today. The main events which characterise this third period are the succession of Barakzai dynasty (Dost Mohammad) to the Durrani dynasty, the three Afghan wars (1838-1842; 1872-1881 and 1919) against the British which ended foreign occupation, and the proclamation on 8 August 1919 of an independent constitutional monarchy (treaty of Rawalpindi), the promulgation of the first written constitution in 1921, and of the present and fifth constitution in 1964. In 1930, the Government of Afghanistan sought to expand agricultural lands by irrigation schemes which were to command an area of 46,540 ha. However, owing to various difficulties, development work fell far short of expectations. After World War II the Government of Afghanistan set about scheduling single or multipurpose projects to harness and regulate the flow of major watersheds and to improve existing irrigation systems in order to increase production and to raise the standards of living of the people.

Hydrological studies on the Helmand River System were initiated in 1947 and were followed up on other rivers, the Kabul, the Hari Rud, the Farah Rud, the Kunduz, the Kokcha, the Khulm, the Balkh, and the Sari-pal, etc. By 1968 some 175 gauging stations, most of them equipped with cableways and automatic recorders, were located in Afghanistan. The Afghanistan Meteorological Institute was established in 1954. It issues a monthly bulletin on temperature, humidity, precipitation, etc.

The Helmand Valley Authority (HVA), on the lines of the TVA in the United States of America, was set up in November 1949 as a semi-autonomous body under the Chairmanship of the Minister of Finance. Its functions include not only the construction of hydraulic structures to reclaim and irrigate land, but also resettlement, housing, public health centres, schools, electric power, cottage and small-scale industries.

The Afghan Government embarked upon a new long-range economic development plan, which became operative on 7 September 1956. The Ministry of Planning was established in April 1957 to co-ordinate the functions of all projects carried out by the various ministries. Emphasis was laid on modern irrigation projects and the approximate cost of the five-year programme for agriculture and irrigation development was US\$ 103.7 million, which represented 20 per cent of the total plan outlay.

A Groundwater Department under the Water and Soil Survey Authority was constituted in 1963. Modern ground-water exploration was taken up in 1964 covering an area of 26,000 km² in Katamaz, Kabul Charikar and Kabul Sarobi areas. Development of land and water resources of northern region and of the Kokcha River for irrigation and hydropower was started in 1964. With the help of FAO irrigation plans for Upper Kabul basin (50,000 ha) and Hari Rud basin (140,000 ha), and with the help of World Bank, Kunduz Khanabad irrigation study were undertaken in 1965.

The rehabilitation of the old irrigation systems and the planning of new systems is being carried out by the Ministry of Agriculture and Irrigation. Technical and financial assistance is rendered by UN International Organisations and friendly countries.

7. IRRIGATION METHODS USED

Of the 5.30 million ha of area equipped for irrigation, 4.80 million ha are irrigable by gravity flow and the remaining by Karez (Kanats) and shallow wells. Furrow and border methods are generally practised.

8. STATISTICS RELATING TO IRRIGATION

Potentially cultivable area	14,000,000 ha
Arable land area 1977	8,050,000 ha
Area equipped for irrigation	5,300,000 ha
Irrigated area 1961-1965	2,208,000 ha*
Irrigated area 1968	2,300,000 ha*
Irrigated area 1973	2,400,000 ha*
Irrigated area 1978	2,600,000 ha*

9. IMPORTANT PROJECTS

The Helmand Valley Project : In the first stage of the development of the project started in 1947 the under-mentioned works were constructed : (a) 100 m high roll-filled earth dam on the Helmand River at Kajakai with storage capacity of 1,800 million m³ ; (b) a roll-filled dam of 50 m height (on a tributary of the Helmand) at Arghandab with reservoir capacity of 460 million m³ ; (c) three major diversion dams in the Helmand; (d) main canals of Boghra, Shamalan, Darweshan, Zahir Shahi,

*FAO Production Yearbook-1979, vol. 33.

Tarnak of 20 to 74 m³/s capacity ; (e) 600 km of laterals ; 1,200 km of sub-laterals and farm ditches with distributary structures ; and (f) 1,200 km of deep drains and secondary drains. These facilities were to develop an area of 80,000 ha in addition to 80,000 ha being already irrigated before developments of the Helmand and the Arghandab valleys.

The Nangarhar Project on the Kabul River near Jalalabad was started in 1960. A 22 m high diversion dam on the Kabul River at Darunta feeds the intake of a canal of 50 m³/s capacity and 70 km of main canals, laterals, sub-laterals and drainage network form the irrigation network. Some 25,000 ha land is irrigated from this scheme.

10. FIELD WATER MANAGEMENT

In the existing irrigation systems 25 to 50 per cent (30 per cent in major canal systems) of the command area remain idle due to chronic water shortage, caused by insufficient capacity of canals and their structures and inefficient water distribution. In the lower reaches of these canals, the farmers have introduced strict rationing systems under which each field receives irrigation supply only every second or third year, depending upon the amount of water available.

The irrigation efficiency in the existing irrigation systems is between 45 and 50 per cent. Technical improvements of the canals are under execution to increase the efficiency to 50 to 55 per cent.

11. PROBLEMS RELATING TO IRRIGATION AND DRAINAGE

(1) In the past, most of the irrigation works have been constructed by farmers, either collectively or by individuals, and they serve about 70 per cent of the area irrigated. The intakes consist of temporary structures and the canals are often inadequate or too long in proportion to the water available. This results in heavy seepage losses. Their improvement and rehabilitation constitutes work of considerable magnitude.

(2) Throughout the country, inefficient use is made of water ; and mostly everywhere due to over-irrigation the ground-water table has risen. In valley lands with sufficient slope and natural drainage channels close by, the rise of ground-water table may not be large, but in the desert and flat land, for example in the southern arid part of the country (in the Helmand valley), the situation has become critical in the absence of natural drainage channels. Due to low rainfall and high evaporation and temperature in the desert area the natural leaching of soluble salts is limited. Therefore, the washing of salts is done by artificial leaching methods, but this adds to the problem of rising water table and causes it to rise to dangerous levels, and extensive drainage consequentially becomes necessary. Much land adjacent to the Kunduz River is not under cultivation because of the high ground-water table.

(3) Heavy silt load movement is common in almost all the streams of the country calling for urgent soil conservation measures.

(4) The biggest handicap is lack of basic and reliable hydrologic data over a long period of years which makes the work of the project designer difficult, resulting in provision of perhaps an unduly high safety factor and in consequential high construction costs.

(5) There is no water code framed in the country, and this leads to conflicting claims from among the water users.

(6) The present methods of water application are furrows, flood or border, which require improvements to suit the concerned topography. The changeover to modern methods requires changes in agricultural methods, crop rotation and soil tillage and the basic need is the adequate training of the farmer.

12. PRESENT DEVELOPMENTS, FUTURE PLANS AND POTENTIALS

The area under irrigation at present is about 2.60 million ha, of which about 1.40 million ha get adequate water. The estimated water potential is 50,000 million m³. Some 5.30 million ha are equipped for irrigation. It is estimated that 0.9 million ha can be further added to the irrigated area from the supplies of the rivers. Potentially cultivable land is estimated at 14 million ha.

The Government of Afghanistan is currently engaged in assessing the ground-water potential. Recent soil surveys have revealed that some lands, heretofore considered wastelands, could be brought under cultivation through irrigation. Commendable efforts are being made to harness the untapped water resources and to improve the existing systems and Afghanistan can look forward to a better standard of living with the development of its water resources.

13. ADMINISTRATION OF IRRIGATION AND DRAINAGE PROJECTS

The existing traditional irrigation systems are owned by the farmers themselves, who are also responsible for their operation and maintenance and for the distribution of water. Following an old tradition, the farmers are organized in informal water associations and elect annually, according to established rules, the water master and his assistant, who in turn are supported in carrying out their duties by the governors of the provinces.

The Ministry of Agriculture and Irrigation builds small canals and operates the main structures and canals down to sub-laterals and from there on the farmers are responsible. The Ministry has made special plans to help the farmers by constructing canal intakes, diversion weirs, diversion structures and turnouts.

The Water and Power Authority has been established under the Prime Minister of the country. This authority has been exercised (1976) with the formulation of the country's Seven-Year Development Plan.

Under the Ministry of Public Works, there is an organization which builds dams and large canals.

The Helmand Valley Authority has a separate entity and has an irrigation division as well as a construction division.

15. FINANCING OF IRRIGATION AND DRAINAGE PROJECTS

Irrigation and drainage works are financed by the Government and, in addition to the conventional tax levied against land, the farmer has to pay a charge for water use and a charge for operation and maintenance of canals and structures.

In the Helmand valley, the repayment of cost for drains is spread over a long period, generally 30 years. Land Levelling in the valley was done by the HVA and is to be repaid by the farmers over a 30-year period.

The major costs of improvement works are paid by the Government, and only a part of charges are payable by the farmer depending on his financial condition. Repayment of the charges is accomplished in instalments spread over a number of years. The cost of local improvements of individual canals, effected by the farmers, where the Government is not engaged over the work, is borne by the landowners themselves. The Agricultural Bank, in accordance with specific rules, makes development loans to the farmers at low interest charges on long duration instalment plans.

Rehabilitation programmes are generally taken up at the request of the farmers themselves. The portion of the work which the farmers can do is left to them and the Government does the remainder. Costs are paid over a 10-year period.

16. NEW TECHNOLOGY AND ITS APPLICATION

The Ministry of Agriculture and Irrigation constructs small pilot irrigation schemes. These small-scale systems are constructed on the border of existing traditional irrigation schemes, and 1,000–2,000 ha of new land are brought annually under pilot schemes.

17. WATER LAWS

The validity of the Customary Law derives from Article 2 of the new Afghan Constitution which states: "Islam is the sacred religion of Afghanistan of the Hanafite doctrine".

Regarding water resources, ownership, right of use, development and conservation, since no written codification has been enacted so far, all aspects are still governed by customary water law, particularly domestic and agricultural uses of water.

LEGISLATION IN FORCE

1. Constitution of Afghanistan, 1964 ;
2. Land Survey and Statistics Constitution of Afghanistan (Land Survey Law), 1965 ;
3. Land Settlement Tax Matters and Water Law for Lands Served by the Kajakai and Arghandab Dams, as amended for Kohistan, Kalagai and Shamalan Project Areas, 1965–to date ;
4. The Law of Pricing and Sale of Water for Land Served by the Kajakai and Arghandab Dams ;
5. The Law of Organization and Legal Authority of the Supreme Court, 1965 ;
6. The Law on the Composition of the Government Administration, 1965 ;
7. The Agricultural Development Bank Law.

Apart from the provisions of the above legislation, Moslem customary law of the Sunni school, Hanafite doctrine, still governs water resources uses in Afghanistan.

18. INTERNATIONAL WATER AGREEMENTS AND TREATIES

Treaty between the Government of Afghanistan and His Britannic Majesty's Government for the establishment of neighbourly relations signed at Kabul on 22 November 1921

Article 2 of this Treaty states : "The British Government agrees that the Afghan authorities shall be permitted to draw water in reasonable quantities through a pipe which shall be provided by the British Government from Landi Khana for the use of Afghan subjects at Tor Kham, and the Government of Afghanistan agrees that British officers and tribesmen living on the British side of boundary shall be permitted without let or hindrance to use the aforesaid (between Shilman Khwala, Banda and Palosai) portion of the Kabul River for purposes of navigation and that all existing rights of irrigation from the Kabul River between Shilman Khwala, Banda and Palosai shall be continued to British subjects."

Exchange of notes between the Government of Afghanistan and His Majesty's Government in the United Kingdom and the Government of India in regard to the boundary between Afghanistan and India in the neighbourhood of Arnawai and Dokalim, Kabul, 3 February 1934

Use of water for irrigation : The people of Dokalim (Afghanistan) shall be allowed to take water required for the irrigation of their lands in Dokalim from the Arnawai Khwar above the boundary [para 2 (a)]. However, without the consent of the local British authorities no new water channel shall be constructed above the boundary (para 3).

Exchange of notes between His Excellency Mr. Molotov, Minister of Foreign Affairs of the Union of Soviet Socialist Republics, Moscow and His Excellency Sultan Ahmed Khan, Ambassador of Afghanistan, Moscow, in June 1946

"I have the honour to inform you that, guided by the desire to settle in a spirit of friendly relations between both parties the question of the utilization of the waters of the river Kushka and the question of the construction of a dam on the river Murghab, the Soviet Government agrees to cancel the order prohibiting the Afghan Party from using water from the river Kushka north of Chihil Dukter as was provided in the documents of the Anglo-Russian Demarcation Commission of 1885-1888. Nevertheless, the Afghan Party shall not increase the quantity of water taken from the river Kushka in this area and shall observe the status quo in this respect."

"The Soviet Government waives the right to construct a dam on the river Murghab and to utilize the Afghan bank of the river for this purpose, on the condition that the Afghan Party does not construct such a dam on its territory in the frontier sector as would diminish the flow of water from this river on to Soviet territory..."

"...In connection with the above, I have the honour to inform you that the Afghan Government agrees for its part with the settlement of the question of the use of water from the river Kushka and of the right to construct a Soviet dam on the river Murghab, contained in your above-mentioned note..."

Treaty between the Government of the USSR and the Royal Government of Afghanistan concerning the regime of the Soviet-Afghan State frontier, signed in Moscow on 18 January 1958

Use of frontier waters and of rivers which flow to the frontier or into frontier waters : The Contracting Parties shall take measures to ensure

that in the use of frontier waters, and of rivers which flow to the frontier or into frontier waters, the provisions of the Treaty and the special agreements between the Government of the USSR and the Government of Afghanistan are observed and their mutual rights and interests are respected (Article 7, para 2).

Internal waters : "National internal" waters are covered by the national legislation of each State, in accordance with general principles of international law (Article 7, para 3).

Operations to prevent changes in the courses of frontier rivers : The competent authorities of the Contracting Parties shall jointly take the necessary measures to remove such obstacles as may cause changes in the course of frontier rivers, streams or canals or impede the flow of water along them. Where joint operations are undertaken by common consent of both Parties, the competent authorities of the two Contracting Parties shall decide the programme of work and shall share the cost equally unless some other arrangement is concluded. The banks must be strengthened wherever competent authorities of the Contracting Parties jointly consider it necessary. Neither Contracting Party shall cause an artificial displacement of river beds. Should the bed of a frontier river be displaced as the result of natural phenomena the Contracting Parties shall correct the bed by joint action (Article 9).

Protection of the banks of frontier rivers. Compensation for material damage : The Contracting Parties shall take measures to prevent deliberate damage to the banks of a frontier river. Where one Party occasions material loss to the other Contracting Party, compensation for that loss shall be paid by the Party responsible therefor (Article 11).

Cleaning of frontier watercourses : Frontier watercourses shall be cleaned out on the sectors where such work is jointly considered essential by the Parties. In cleaning out frontier waters, the objects removed shall be thrown out to such a distance from the bank as to avoid any danger that the bank might fall in or the river bed be polluted, and so as to prevent the flow of water from being obstructed in time of flood (Article 12).

Exchange of information concerning the level and volume of water in frontier rivers : The Parties shall exchange as regularly as possible such information concerning the level and volume of water in frontier river and also concerning precipitation in the interior of the territory of the two Parties as might avert danger or damage from flooding (Article 17).

Erection of structures for the collection and diversion of water that has overflowed the banks : No structure may be erected by or near a river which, in time of flood, would obstruct or impede, to the detriment of the other Party, water that has overflowed the banks from returning by natural drainage to the main river bed. The Parties shall agree on a system of drainage into frontier waters, the diversion of water and on other matters associated with the use of frontier waters (Article 18).

Preservation and use of existing structures : Existing dams, dikes and other similar structures on frontier watercourses shall be preserved and may be used (Article 19, para 1).

Erection of new structures : Dams and other similar structures likely to influence the flow of water, dikes which might affect the flow of water and the state of the banks and installations that might change the water level

of the river might not be erected on frontier watercourses except by agreement between the Parties (Article 19, paras 1, 2 and 3).

Use of water : Both Parties shall be allowed free use of frontier waters up to the frontier line (Article 8, para 1). Questions concerning the use of frontier waters shall be governed by special agreement between the Parties (Article 16).

Watering : Nationals of the two Parties shall be entitled to water their livestock at frontier rivers (Article 14).

Fishing : Nationals of the two Parties may fish in frontier waters up to the frontier line in accordance with the regulations in force in their respective territories, but are prohibited from (a) using explosive, poisonous or narcotic substances and (b) fishing at night. Matters relating to the preservation and breeding of fish in frontier waters and other economic measures concerning fishing may be regulated by special agreement between the Parties (Article 22).

19. RESEARCH ON IRRIGATION AND DRAINAGE

The Helmand Valley Authority (HVA) is conducting research studies in the Nad-i-Ali area on spacing of tile drains. In addition, this Authority has also carried out experiments on water requirements of crops and it is concluded that 1 million m³ of water will satisfy crop needs of 110 ha. In other regions of Afghanistan, where temperature, evaporation and salinity are considerably lower, the corresponding figure of 150 ha is considered adequate.

20. OTHER FEATURES

The basis of design of canals is 714.5 ha/m³/s of water, irrespective of crop, although demand and irrigation habits of farmers are taken into account. In some cases this may go as high as 1,042 ha/m³/s.

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ALGERIA*

1. PHYSIOGRAPHY

Algeria, a territory extending over 1,000 km along the Mediterranean coast of North Africa, lies between the latitudes 19° N and 37° 20' N, and the longitudes 12° 8' E and 8° 50' W. It is bounded on its landward sides on the east by Tunisia and Libya, on the west by Morocco, on the south by Mauritania, Mali and Niger and on the north by the Mediterranean sea. The total area of Algeria is 2,381,740 km².

Algeria is divided by the ranges of the Atlas mountains into three longitudinal zones: the Mediterranean zone known as the Tell; the semi-arid zone called the High Plateaus; and the Sahara zone. The Tell, a generally fertile region, extends 80 to 160 km inland between the sea and the Maritime Atlas range, which runs parallel to the coast.

The semiarid zone (or the High Plateaus zone) is a gigantic trough, very flat at the bottom and steppe-like in character. The characteristic growth is esparto grass providing pasturage for itinerant flock. Roughly along the central axis there are a series of shotts (low-lying areas where small quantities of runoff collect and evaporate) — Shott Gharli, Shott el Chergui, the two Zahrez and Shott el Hodna — which are of great importance in the water cycle.

The Sahara, lying to the south of the Atlas, is a true desert of more than 1,000,000 km² surface, in which the only inhabited areas are a few oases around the rare springs. The most valuable area to man is the northern belt with altitudes varying from about 1,000 m in the west to 80m below sea level in the east.

It is in the northern belt that the oueds (streams) descending from the zone to the north disappear below the erg or end in closed depressions. The Cheliff River, 696 km long, is the only river rising in the Sahara desert which reaches the sea.

2. CLIMATE AND RAINFALL

The coastal plains have a typical Mediterranean climate with hot dry summers and mild rainy winters. Temperatures average 10°C in winter and 24°C in summer. Inland on the plateau and in secluded valleys, the winter temperature averages 4.4°C, the summer 27°C, and the climate is typical of the steppe. The Sahara climate is tropical and the average summer temperatures range from 34.4°C to 40.5°C.

Rainfall in Algeria is irregular and varies greatly from year to year. Rainfall diminishes from January to August and increases from September to December; from June to September little rain falls. Rainfall also decreases from the north to the south and from west to the east. The annual rainfall is more than 400 mm in the coastal region of about 80 to 160 km width, but is unequally distributed from the west to the east; it

*Information updated in ICID (CIID) Central Office

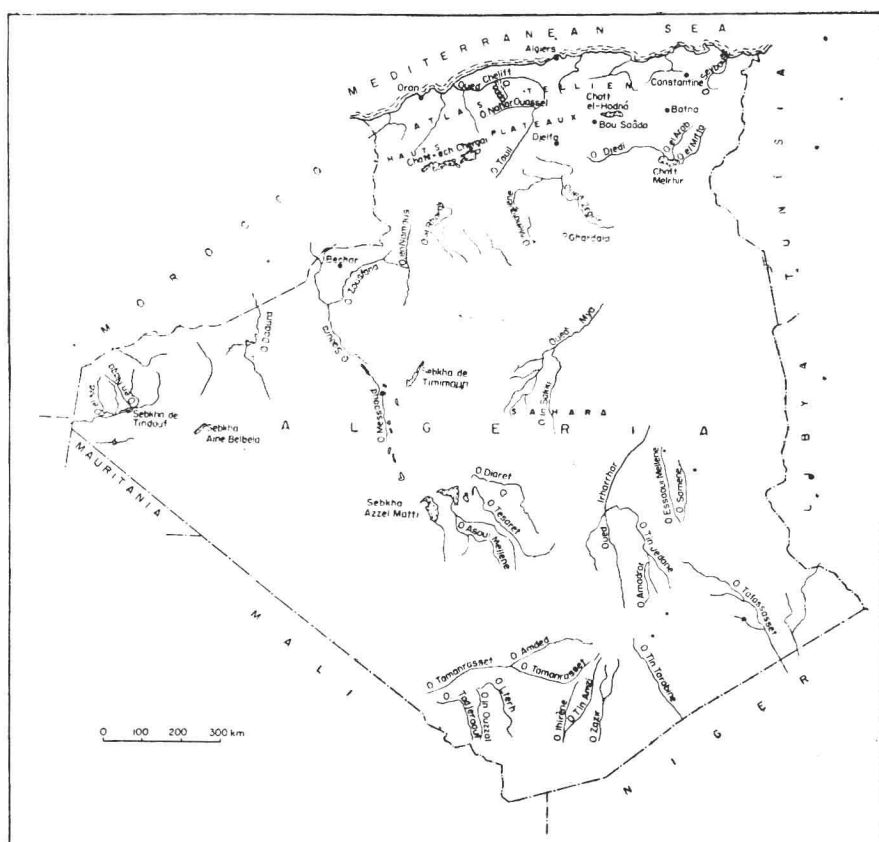


FIGURE 1 : Map of Algeria

drops below 400 mm in the Department of Oran which has vast fertile stretches of land, it exceeds 800 mm in the Department of Algiers, and is more than 1,000 mm in the Department of Constantine where, unfortunately, cultivable lands are limited. It is less than 200 mm in the Saharan Atlas enclosing the steppe region and is virtually nil in the Sahara itself.

These vagaries of climatic and rainfall characteristics indicate that irrigation is very important in Algeria for successful agriculture.

3. POPULATION AND SIZE OF HOLDINGS

The total population of Algeria was 13.30 million in 1970 and 17.53 million in 1978, of which 9.12 million is agricultural population. Of the total economically active population of 3.90 million of the country, 2.03 million (or about 52 per cent) are actually engaged in agriculture.

Land ownership in the private sector (traditional sector) is subject to different laws from those of the Socialist sector. There is still an unequal distribution of land among farmers. There are many big land owners, and that much arable land is owned by urban people or others, who do not practise the profession of agriculture.