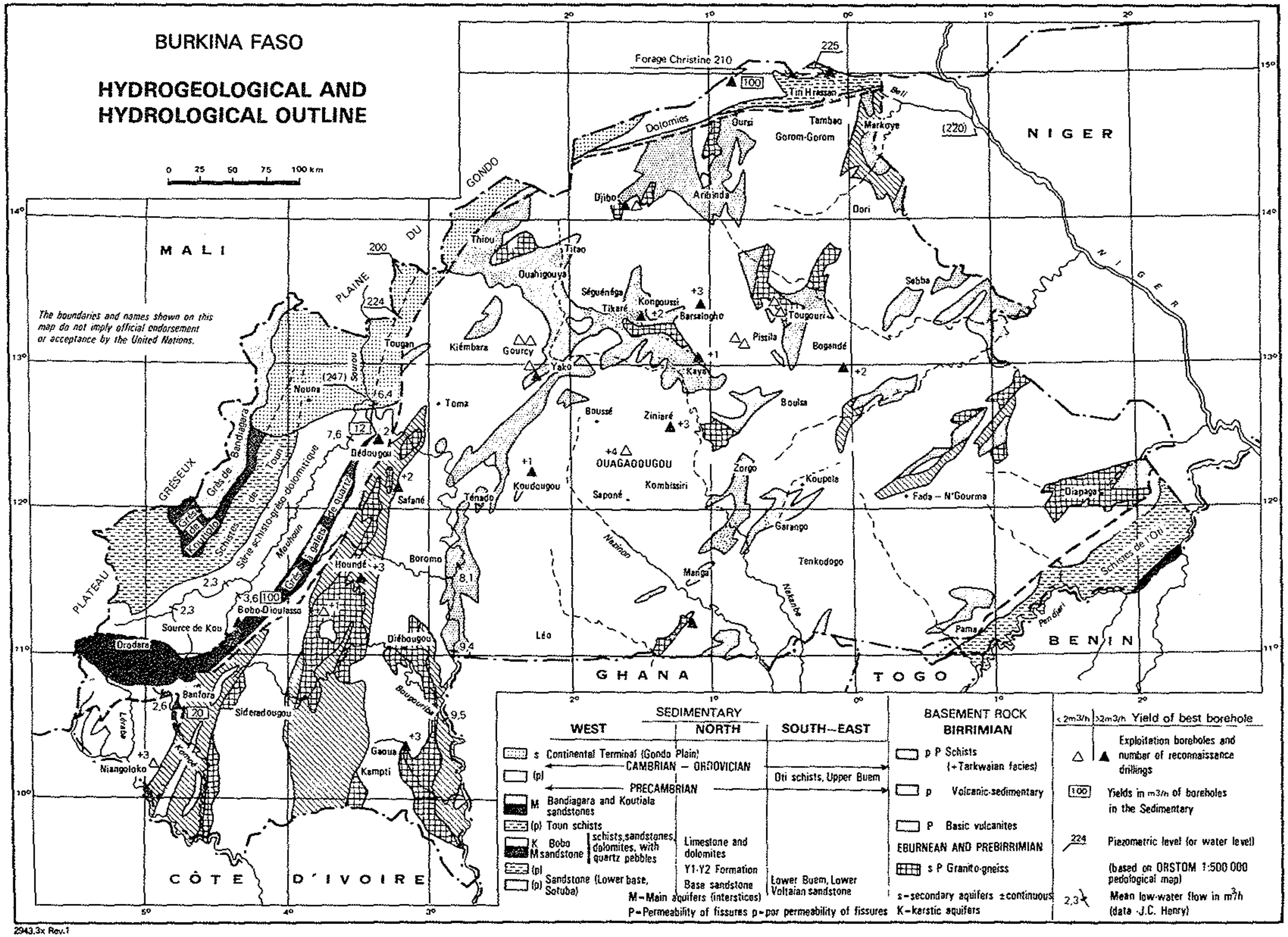

BURKINA FASO
HYDROGEOLOGICAL AND HYDROLOGICAL OUTLINE
0 25 50 75 100 km
The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.
MALI
NIGER
GHANA
TOGO
BENIN
CÔTE D'IVOIRE
PLAINE DU GONDO
PLATEAU GRÉSEUX
Forage Christine 210
Dolomies
Tin Hrassan
Gorom-Gorom
Markoye
Djibo
Aribinda
Dori
Thiou
Titao
Ouahigouya
Séguénéga
Kongoussi
Barsalogho
Tougouri
Pissila
Bogandé
Sebba
Kiémbara
Gourcy
Yako
Kaya
Tougan
Nouna
Sourou
Toma
Boussé
Ziniaré
Boulsa
OUAGADOUGOU
Kombissiri
Saponé
Koudougou
Ténado
Dédougou
Safané
Zorgo
Koupela
Fada – N'Gourma
Diapaga
Schistes de l'Oti
Garango
Tenkodogo
Manga
Nazinon
Nakambe
Pama
Pendjari
Léo
Boromo
Houndé
Bobo-Dioulasso
Source de Kou
Orodara
Banfora
Sideradougou
Diébougou
Bougouriba
Gaoua
Kampti
Niangoloko
Komoé
Léraba
Grès de Bandiagara
Grès de Koutiala
Schistes de Toun
Série schisto-gréso-dolomitique
Mouhoun
Grès à galets de quartz
2943.3x Rev.1
SEDIMENTARY
WEST | NORTH | SOUTH–EAST
s Continental Terminal (Gondo Plain)
CAMBRIAN – ORDOVICIAN
(p) | Oti schists, Upper Buem
PRECAMBRIAN
M Bandiagara and Koutiala sandstones
(p) Toun schists
K Bobo M sandstone | schists, sandstones, dolomites, with quartz pebbles | Limestone and dolomites
(p) | Y1-Y2 Formation
(p) Sandstone (Lower base, Sotuba) | Base sandstone | Lower Buem, Lower Voltaian sandstone
M=Main aquifers (interstices)
P=Permeability of fissures p=por permeability of fissures
BASEMENT ROCK
BIRRIMIAN
p P Schists (+Tarkwaian facies)
p Volcanic-sedimentary
P Basic vulcanites
EBURNEAN AND PREBIRRIMIAN
s P Granito-gneiss
s=secondary aquifers ±continuous
K=karstic aquifers
<2m3/h >2m3/h Yield of best borehole
Exploitation boreholes and number of reconnaissance drillings
100 Yields in m3/h of boreholes in the Sedimentary
224 Piezometric level (or water level) (based on ORSTOM 1:500 000 pedological map)
2,3 Mean low-water flow in m3/h (data J.C. Henry)

BURKINA FASO

Area: 274,200 km^2

Population: 6.61 million (United Nations estimate, 1983)

I. BACKGROUND

Burkina Faso is a landlocked country in West Africa: a vast, flat and regular peneplain most of which is between 250 and 350 metres above sea level. The monotony of the landscape is broken by a number of mountain chains which follow the geological configuration, mainly in the south-west and to the north of Ouagadougou: elongated parallel ridges made up of Birrimian schists and quartzites and sometimes capped with a thick lateritic cuirasse, or piles of rounded boulders of granitic origin. The high point is Mt. Tēna Kourou (749 m) near the Mali frontier in the south-west, and the lowest part of the country is located in the south-east near the borders of Benin and Togo (below 200 m). In a straight line, Burkina Faso's southern frontier is more than 600 km from the Atlantic coast, and the northern frontier is within the loop of the Niger, between a few dozen and a few hundred kilometres distant from the river.

Climate

From October to April/May the climate is dominated by a dry flow of air from the high pressure centres of the Sahara, giving hot days and cool nights, while from May/June to September there is a flow of moist air from the oceanic high pressure centres of the southern hemisphere.

Between mid-April and mid-June and between mid-September and mid-November there are brief alternating periods of dry and moist air flows.

This over-all pattern is influenced by latitude.

Thus the north of the country or "Sahelian zone" has a short rainy period with great variation in the amount of rainfall, and a dry period aggravated by intense evapotranspiration, with wide daily and annual temperature ranges. At Dori on the 650 mm isohyet it rains on 54 days a year on average and the potential evapotranspiration is generally in excess of two metres for an average annual temperature of between 28.5°C and 29°C (maximum temperature 45.4°C and minimum 6.8°C).

The central zone comprises the larger part of the country, leaving the Sahelian zone in the north and a narrow strip along the southern frontier which widens out only in the south-west. This zone has a longer rainy season which can last six months in an exceptional year. It is located between the 650 mm isohyet (which separates it from the Sahelian zone) and the 1,000 mm isohyet to the south and south-west. At Ouagadougou, between the 800 and 900 mm isohyets, it rains on 75 days a year on average annual temperature in the order of 28°C (maximum temperature 42.6°C and minimum 9.5°C).

The southern zone, to the south and south-west of the 1,000 mm isohyet, has rainfall for about half the year and a fairly low annual temperature range. At Bobo Dioulasso, between the 1,100 and 1,200 mm isohyets, it rains on 93 days a year on average, the potential evapotranspiration is between 1,700 and 1,800 mm, and the average annual temperature is below 27°C (maximum temperature 41.6°C and minimum 10°C).

Surface water

Burkina Faso is crossed from north-west to south-east by the watershed between the Niger basin and those of the Voltas. The centre, the south and the west are drained by the White, Red and Black Voltas and by the Comoé and its tributary the Léraba. The extreme south-east is drained by the Pendjari, itself a tributary of the Voltas.

The north and the east are drained by the right-bank tributaries of the Niger, which are temporary rivers linking a "string of waterholes" (some of which remain wet throughout the year) and they are of great importance for livestock raising. The only permanent rivers are the Black Volta, the Comoé and the Pendjari, of which the Black Volta is by far the best fed, with an average flow at Banza of 13 m^3/s and a minimum flow in March/April of about 2.8 m^3/s. The minimum flow of the Comoé falls to below 2 m^3/s from March to June and that of the Pendjari is in the order of 500 l/s in March/April.

Many of the valleys are dammed in order to accumulate the water in the rainy season. The country is dotted with more than 700 dams of varying size, depending on the topography, the amount of recharge and the techniques used in their construction (sometimes very rudimentary). The Loumbila dam which supplies Ouagadougou with drinking water has an area of 1,000 ha, with a maximum depth of 6.5 m, while some of the small dams collect no more than a few thousand cubic metres of water, with depths of about one metre, and they dry up completely in the course of the year. The maintenance of these installations is a major concern in view of the risk which they offer to downstream installations and low-lying areas.

The country has a number of natural lakes. These are Lake Bam, which occupies the fossil bed of an ancient tributary of the White Volta; it is about 20 km long and about a kilometre wide and it dries up about every seven years (FAO report cited); Lake Dem, which at its low-water level covers a few hundred hectares; Lake Kou, with an area of about 100 ha at low water; and the "hippo pool" fed by the Black Volta, and the Tengréla and Karfiguéla waterholes, located near Banfora.

Geology

The crystalline formations of the African Precambrian basement rock cover more than 80 per cent of the area of Burkina Faso.

In the Gondo plain in the extreme north-west, the tertiary continental deposits of the "terminal continental" formation rest in unconformity on the Precambrian formations "A".

- The Precambrian crystalline formations "C" and "D", granites and gneiss, schists, quartzites and green rocks, are generally impermeable. However, the altered or fractured zones constitute important local aquifers which can be used for village water supplies.

- The Precambrian sediments "A" have at their base sandstone-quartzites and conglomerates, then mainly sandstone formations interbedded with schists and rare dolomitic limestones in the west of the country which give rise to perennial springs in places (for example, Kou), then heterogeneous formations of argillaceous schists, quartzitic sandstones, interbedded limestones and dolomites, brecchias, and marbled intra-formational conglomerates, which represent the peripheral facies of the subsidence basin of the Gourma running down from the north (Mali and Niger). These formations are aquifers in places. Many sandstone facies (Gobinangou sandstone) are found in the south-east of the country, with typical tillitic strata overlain by an important formation: the series of Pn edjaride pelitic schists and lydites with calcareous and phosphated strata. These formations have hydrogeological potential.

- The terminal continental formation of Gondo, consisting of sands and clays, is a continuous aquifer connected with the underlying dolomites.

II. GROUND WATER

Bodies concerned

The Department of Hydraulics and Rural Development (DHER), which was set up in July 1984, is responsible, inter alia, for:

- The inventory of the country's water resources;
- The hydrological hydrometric and hydrogeological studies required for the evaluation of the country's water resources;
- The studies required for the determination of a policy for water resources development and the corresponding installations;
- The preparation of national programmes for the development of water resources for domestic, agricultural and livestock, and energy needs, and for the development of rural areas;
- The planning, preparation, monitoring and evaluation of water infrastructure programmes;
- The co-ordination of all water resources activities;
- The drafting of laws and regulations governing the use of water resources.

DHER has three quasi-State bodies under its technical control:

a) The National Water Office (ONE) which is responsible for "the management of all undertakings and all operations directly or indirectly affecting the storage, treatment and purification, transport and distribution of untreated water and drinking water. It may also be required to attend to the treatment of waste water before its disposal or to recycle this water in the supply system".

b) The National Office of Dams and Irrigation (ONBI), which is responsible for "building rural dams and supplying water to the plains. It is also responsible for the establishment, management and maintenance of agricultural production infrastructures: dams, rice fields, pumping stations, fruit and vegetable packaging and preserving centres, etc., in liaison with training bodies and producers' organizations...".

c) The Rural Development Fund (FDR), which is responsible for "the mobilization, co-ordination and management of funds for the promotion of social and economic development for the rural population with its participation". The FDR is therefore active in the surface- and ground-water sectors.

In addition, the Volta Valleys Development Authority (AVV), responsible to the Ministry of Rural Development, plans and implements water programmes for the repopulation of the valleys of the Voltas and for the utilization of the fertile land. In addition to the Ministry of Rural Development, there are several other ministries with important responsibilities in the area of water:

The Ministry of Public Health is responsible for the quality of drinking water and the protection of drinking water supplies, as well as for health education;

The Ministry of Equipment and Communications is responsible for urban development and rules on matters of individual sanitation installations;

The Ministry of Trade, Industrial Development and Mines regulates the industrial use of water and is responsible for the campaign against the pollution of the environment by industrial wastes.

The Ministry of Finances contributes to water policy in that it controls the use and distribution of public funds for all State actions with respect to drinking water and sanitation.

The Ministry of Planning and Co-operation is responsible in the sector for the overall planning and mobilization of the financing needed for the country's economic and social activities.

The Technical Water Committee was set up in 1978 as an inter-ministerial co-ordination body; it also acts as a national action commission for all matters of drinking water supply and sanitation.

Lastly, the Water Code came into force on 1 April 1983.

Background of Hydrogeological Research

It was not until 1954 that the first hydrogeological studies were made; they consisted mainly of inventory work and the supervision of prospecting operations. Some 700 wells were dug between 1952 and 1961. Regional studies were then undertaken, some with the assistance of a United Nations expert.

In December 1979 the Inter-State Committee for Hydraulic Studies (CIEH) published a summary of hydrogeological knowledge about the territory, which listed 53 studies in chronological order, and included the summary table which appears below.

Village water supply programmes are now being carried out throughout the country. These programmes have been preceded by local studies on the establishment of water points. In bedrock areas, i.e. in the great majority of cases, it is a question of identifying deep fissures. The techniques used generally include field surveys, an interpretative study of aerial photographs and geophysical prospecting exercises, In these exercises use is generally made of geo-electrical and aerial geophysical methods and soundings. However, research is being carried out to refine these methods (especially with respect to multi-directional aerial prospecting) and to introduce seismic, microgravimetric, magnetic and electromagnetic techniques. Specialized national personnel are usually assigned to the projects (hydrogeologists, drillers and drilling assistants, well-diggers), except in the case of the geophysical unit which is attached to the Ground Water Service at Ouagadougou and has three electrical prospecting and one seismic prospecting sets of equipment. However, this unit lacks the resources and qualified personnel to cope with the very large volume of work involved in the establishment of several hundred water points per year throughout the country.

In practice the water points are first established on the basis of geomorphological surveys using aerial photographs. In the event of failure or when a priori the area is very unfavourable, the geophysical team is called in. According to the CIEH report on the state of hydrogeological knowledge of the country, the main ground-water resources are:

- Aquifers in lateritic cuirasses: when the cuirasses are submerged, these water-bearing strata constitute a major resource. Their good consistency means that they can be tapped by unlined wells (especially in the area of Koudougou);

- Sand aquifers: traditional wells are limited by the poor consistency of the formations: they cannot tap the water of the granular sands lying at the base of the alteration profile and they can exploit only the unproductive argillaceous sands. The granular sands, when they are present, can be reached only by modern wells;

- Alluvial aquifers: they are very local and are exploited by sump holes;

- Aquifers in fractures of the crystalline basement rock. Drilling with "down-the-hole hammer rigs" has made it possible to exploit these strata, which were not suitable for modern wells or wells dug by excavators such as the "Calweld". The use of this new technique has made it possible to obtain better yields from the installations constructed under the Volta Valleys (AVV) and village water supply (DHER) programmes;

- Sandstone aquifers in the west and south-east of the country (sedimentary basin);

- Sand aquifers in the terminal continental formation of the Goudo plain. Deep wells must be drilled to exploit the deep permeable strata.

Summary of Studies

	Author	Year	Purpose	Content	Proposals
Hydrogeology of Nord-Dori	BURGEAP	1954	R P	C P	
Material on the Hydrogeology of Upper Volta	BURGEAP	1954	R		
Material on Installations in Nord-Dori	BURGEAP	1957			F M
Resources and Needs of the cercles of Boulsa, Bogandé, Dori Sud	GERHAV	1962	R	C P B	P B
Water resources of Ouahigouya	SCET	1963	R B P	D	B
Ougadougou water supply	SCET	1964	R P	Ge C	
Data for the equipment of five cercles in southern Upper Volta	BURGEAP	1964	R B P	C P	P Ge
Critical data on the SATEC wells campaign	BURGEAP/SATEC	1965	P	D	
Hydrogeology of Nord-Voltaique: Markoye, Darkoye, Kouyera	DGM	1965	R P	F	
Hydrogeology of Ténado cercle	BRGM	1965	R	C P	F P Ge
Hydrogeology of Boussé and Ouagadougou cercles	BRGM	1965	R	P	F P
Preliminary hydrogeology of Bangao depression	DGM	1966	R	F	M
Water resources of Yako cercle	BRGM	1966	R	C P	F P Ge
Hydrogeological survey - supply for 20 urban centres	BRGM	1966	R P	F Ge C	F P
Hydrogeological survey of Koudougou cercle	BRGM	1967	R B P	C P	F P Ge
Ground water resources in Toma cercle	BRGM	1968	R B P	C P D	F P Ge
Mining and ground water resources in Upper Volta	COMTEC	1968	R B P	F GesC P D	F P
Water resources in Tougan cercle	BRGM	1969	R B P	C	F P
Hydrogeological study - cattle trail	BRGM	1969	R B Pa		P
Ground water resources in Nouna cercle	BRGM	1969	R B P	C P D	F P S
Ground water resources in Zorgo cercle	BRGM	1970	R B P	C P	F P Ge
Hydrogeological studies in Oudalan	UNDP	1971	R P	see Hydrogéo	1971
Hydrogeological study in the north of Upper Volta	HYDROGEO	1971	P	F Ge Ci	
Ground-water resources in Kaya and Pissila cercles	BRGM	1972	R B P	C P	F Ge
Hydrogeological study - Tambao water supply	HYDROGEO	1972	P	Ge	B
Summary of carbonate formations in Oudalan	BRGM	1973	P	C	Ge
Ground-water resources in Boulsa cercle	BRGM	1973	R B P	C P	F P
Ground-water resources in Diébougou cercle	BURGEAP	1973	R B P	C	P B
Ground-water resources in Dédougou cercle	BRGM	1973	R B P	C P	F P Ge
Hydraulic programme in the Sahel	SCET	1973	R	P	F P B Ge
Hydrogeological studies: First phase AVV	LCHF	1974	R P I	F Ge	
Resources and needs in Diapaga and Fada N'Gourma cercles	BRGM	1975	R B P	C P	F P B
Hydrogeological studies - Ranch de Léo installation	LCHF	1975	R Pa	F Ge C D	F B
Ground-water resources of Yatenga ORD	BURGEAP	1975	R B P	C P	F P Ge
Hydrogeological studies: Second phase AVV	LCHF	1975	R P I	F Ge	

Summary of Studies (continued)

	Author	Year	Purpose	Content	Proposals
Sahel Emergency Mission - 26 urban centres	BURGEAP	1975	P	F Ge D B	
Hydraulic resources - Centre-East of Upper Volta	UNIV.ST.MONTPE.	1975	R	F C D	
Hydrogeology of Haute-Sissili	UNIV. GRENOBLE	1975	R Pa	F Ge Ci D	
Hydrogeological mission in Bani region	DHER	1976	R P		F
Report of the 1975-1976 drilling campaign - North Upper Volta	DIWI WALTER	1976	P	F D	
Hydrogeological studies: third phase AVV	LCHF	1976	R P I	F Ge	
Water resources in Kongoussi and Barsalogho sub-prefectures	BURGEAP	1976	R B P	C P D B	F P Ge
Progress of work on the Dori-Djibo road	SEGIRACO	1976			M
Hydrogeology of Boromo, Fada, Koupéla, Nouna centres	DHER	1976	R P	P	Ge
Hydrogeological studies: fourth phase AVV	LCHF	1977	R P I	F Ge	
Water resources - Est-Banfora livestock reception zone	DHER	1977	R Pa		
Hydrogeological studies: fifth phase AVV	LCHF	1978	R P I	F Ge	
Water resources inventory of Comoé ORD	IWACO	1978	R B P	GesC P	F P Ges S
Ground-water resources in the Bougouriba valley	UNDP	1978	R P	F Ge	
Hydrogeological studies for the cattle trail - Ouest-Volta	DPEOV	1978	R Pa		P
Water supply for nine secondary centres	DHER	1978	R P	F Ge C D	Ge
Ground-water resources in the Bougouriba valley	UNDP	1979	R P	F	
Fracture systems in Upper Volta - Landsat photographs	FAO	1979	R Landsat satellite imagery study		

Key

Contents

R: Estimate of resources
B: Estimate of needs
P: Human water supply
Pa: Livestock water supply
I: Irrigation

F: Drilling works
Ge(s): Electrical geophysics (and seismic)
C: Chemical analysis
Ci: Chemical and isotopic analysis
P: Water-point card index
D: Discharge test
B: Dams

Works proposed following the study

F: Drilling
P: Wells
B. Dam

Ge: Electrical geophysics
M: Development of water holes
S: Tapping of springs

Not enough data are available for an evaluation of the yield of the aquifers. The discharge of village water points rarely exceeds a few M^3/h and no pumping trials have been undertaken. However, the widespread decline in piezometric levels, which seems to have been going on for some years and has caused the exhaustion of some wells, remains a source of concern.

At present, the aquifers do not seem threatened by over-exploitation owing to the low dewatering capacity both by traditional wells and by hand or foot pumps. The damming of surface water usually has to be undertaken for supplies to urban centres.

With respect to the physical and chemical characteristics of the water, the CIEH report states that the water usually has a low mineral content and is aggressive and of good chemical quality. The submerged cuirasse strata have high a iron content. Bacteriological pollution is common when the aquifers are tapped by sump holes or in the vicinity of big urban centres (poor bacteriological quality of the aquifer in the alterites close to the Ouagadougou dams).

In view of the lack of information on ground-water resources, the Government has sought financing for a detailed inventory of the country's water potential, including:

- Village surveys on present supplies to the people - prior to the launching of village water-supply projects;

- An estimate of the reserves and buffer stocks in the drawoff zones;

- An estimate, by means of piezometric checks, of the resources of the crystalline bedrock;

- An analytical study of fracturation based on aerial photography and field surveys;

- The development of simple geophysical techniques suited to the country's geology, and the implementation of accurate drilling campaigns.

Mention must also be made of the current study of the country's water balance financed by the Netherlands and carried out by IWACO, and of the establishment by DHER's Ground Water Service of a computer file of ground-water points, with assistance from the UNDP/DTCD project for strengthening DHER.

III. EXPLOITATION OF GROUND WATER

Two of DHER's services are responsible for the development and exploitation of ground water: the Ground Water Service for the village water supply programmes, and the Urban and Industrial Water Service for the water-supply programmes for towns and industrial establishments. As organized at present, the Ground Water Service includes the study and programming office with its hydrogeology and water-points index sections, the office of works, with its geophysical and drilling sections, the projects office, and the water analysis laboratory. The Urban and Industrial Water Service includes the water supply office, with a section dealing with urban and semi-urban water supplies and a section for industrial water supplies, and the sanitation office, with its waste-water and rainwater sections. In 1984 these services had the following staff:

- Ground Water Service: five engineers, eight senior technicians, one works supervisor;

- Urban and Industrial Water Service: four engineers, four senior technicians;

- Staff assigned to projects: five engineers, 11 senior technicians, 65 permanent and 500 temporary employees providing administrative support and manpower for the works units.

The engineers and senior technicians usually have suitable qualifications, notably from the Inter-State Rural Development School at Ouagadougou and the School for Senior Technicians in Hydraulics and Rural Development at Komboinsé, or even from abroad. However, there are still not enough of them.

Training and further-training courses are organized for field staff either centrally or as part of the projects. However, the training needs remain very large.

The logistical means available to DHER for the implementation of the works consist of a fleet of 105 light and 66 heavy vehicles; there were also six drilling units in 1984.

There are seven repair workshops/garages; at Ouagadougou, Bobo Dioulasso, Dédougou, Banfora, Ouahigouya, Koudougou, and Kaya.

The diversity of the equipment and the shortage of spare parts mean inadequate maintenance and repair. The result is that the equipment is out of use for long periods and generally underused.

The sinking of the boreholes and wells is divided among State and private bodies which have the resources summarized in the following table taken from the June 1983 CIEH report cited in the bibliography.

Annual Installation Capacity for Wells and Boreholes in Burkina Faso

Bodies	Boreholes: Machine	Boreholes: Boreholes Type	Boreholes: Theoretical annual capacity	Wells: Machines	Wells: No. of teams	Wells: Annual capacity
	2 SH 70	R MFT	160			
	1 Dando	B	30			
DHER	1 Dando	R B	60		7	250
	1 IR.TH 60	R MFT	100			
BUVOGHMI	2 Failing	R MFT	200			
AVV	2 Stenuick HS 66 D	MFT	200	1 Calweld	-	80
National army	1 Schafer	MFT	50			
Aforcom	2 Stenuick HS 66 D	MFT	250	-	-	
SADE						150
NGO */				-	-	100
Total	13		1,150	1	7	480

R: Rotary; B: Percussion; MFT: Down-the-hole hammer.

The operations carried out by the Administration (DHER) in the two campaigns of 1977-1978 and 1978-1979 were as follows:

Boreholes

Campaign	Total: Number	Total: Metrage	Positive: Number	Positive: Metrage	Percentage failures
1977-1978	78		51		35
1978-1979	69	2, 81	52	2,200	25
1979-1980	47	1,770	33	1,190	30
Average	65	2,375	45	1,650	30

*/ NGO activities are not negligable but they are not integrated in the national programme despite the efforts of the Permanent Secretary for Non-Governmental Organizations.

Wells

	New wells			Deepened wells		
	Total	Positive	Percentage failures	Total	Positive	Percentage failures
1976-1977	172	148	14	16	14	12
1977-1978	112	91	19	76	69	9
1978-1979	148	132	10	42	36	14

It will be noted that the actual drilling is below the theoretical capacity, i.e. 40 per cent for boreholes and 60 per cent for wells. This is due in part to the unreliability of the equipment and the difficult hydrogeological conditions.

The zones of rolling alteration require rigs equipped with advanced casing systems for drilling by down-the-hole hammer with eccentric bits. As the existing machinery does not have this equipment, use is made of temporary casing installed by cutting, but the drilling rate suffers.

It should be note that the units equipped with mud pumps very rarely make use of this advantage.

The sinking of wells encounters the same difficulties with respect to hydrogeological conditions and inadequate equipment. The capacity of the derricks (900 kg) is too low to permit digging by excavator. A capacity of 1,500 kg and a faster lifting speed would be useful in certain loose formations. Again for reasons of capacity, the filter tubes cannot be manufactured on the surface and then lowered, which would mean they could be of better quality with regular distribution of the draining channels; this would speed up operations by making the tubes immediately available to the drilling crews so that they would not have to wait for the concrete to set, as is the case when the filter column is poured down the well.

Use of ground water

The available yields remain low for both wells and boreholes. The wells supply only 5-10 m^3/day and they are often dry during certain periods. The rural boreholes are equipped with manual pumps and the yield rarely exceeds one m^3/h.

It is estimated that there were 3,500 modern water points in Burkina Faso in July 1980 and 5,500 in July 1984. A thousand water points were established during the 1983/84 campaign.

To meet the objectives of the International Drinking Water Supply and Sanitation Decade, a total of almost 10,000 would be required by 1985 to deliver 10 litres per day per inhabitant, and almost 20,000 by 1990 to deliver 25 litres per day per inhabitant.

Eighteen urban centres are at present equipped with a drinking-water network supplying a total population of 320,000. Half of the supply is provided through private connections and the other half through public standpipes. The average rate of cover of the population of these centres is 50 per cent. The total investment during the five years 1978-1983 for the 18 centres amounted to almost CFAF 7.5 billion.

The industrial water consumption included in the urban statistics accounts at present for five to six per cent of the total consumption at Ouagadougou and Bobo Dioulasso. In exceptional cases it is much higher. For example, the VOLTEX textiles complex at Koudougou consumes 370,000 m^3/year.

The present situation with regard to agricultural water supplies can be summarized as follows:

- Downstream of the dams: a little over 5,000 ha, including 3,900 for the Banfora sugar complex alone.

- Pumping or diversion: about 3,000 ha developed, mainly planted with rice, vegetables and fruit;

- Improved flatlands: a few hundred hectares planted with rice during the rainy season;

- Unimproved flatlands: between 3,000 and 4,000 ha fully developed, used for rice growing in the rainy season.

The agricultural water-supply projects which have been identified or are under study involve a total area of about 90,000 ha. The largest of these projects will also be used for electricity production.

The main limitation on the intensive exploitation of ground water stems from the nature of the deposits. The unit yields are generally low for the 80 per cent of the country's area made up of crystalline formations. Moreover, for some years there has been a decline in the piezometric levels because the rainfall has been insufficient fully to recharge the aquifers.

In many cases the water in the surface reservoirs is used to supply urban areas, either directly after treatment or by means of wells or boreholes tapping the aquifer underlying the dammed lakes. However, favourable conditions for the artificial recharge of ground-water aquifers are rarely found in Burkina Faso.

IV. CONCLUSION

At present in Burkina Faso, as in the past, ground water is used mainly to supply rural dwellers; it is being increasingly exploited by means of boreholes equipped with hand or foot pumps.

The cost of this kind of borehole, including the development of the wellhead area and the village education work, is in the order of CFAF 4 million. The cost of maintaining and repairing the pumps is estimated at CFAF 50,000 per year on average. On the basis of a water point for every 500 inhabitants, this means an annual expenditure of CFAF 100 per inhabitant, with the basic investment usually financed by external aid; from the economic standpoint, the provision of drinking water to the rural population is essentially a social charge. However, further development of the water points might be envisaged in future if the yields exceed the requirements of the human population; the surplus will be used for small-scale activities (potteries, brickworks), the irrigation of small gardens and the watering of sedentary livestock. Nevertheless, there will be no spectacular development of the resources owing to the nature of the aquifers (mainly discontinuous) which limits the available yield per water point.

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