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Hydrologic Balance and Surface Water Resources of the Cheliff-Zahrez Basin

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***Abstract*—**The Cheliff basin offers a good hydrological example for the possibility of studying the problem which elucidated in the future, because of the unclearity in several aspects and hydraulic installation. Thus, our study of the Cheliff basin is divided into two principal parts: The spatial evaluation of the precipitation: also, the understanding of the modes of the reconstitution of the resource in water supposes a good knowledge of the structuring of the precipitation fields in the studied space. In the goal of a good knowledge of revitalizes them in water and their management integrated one judged necessary to establish a precipitation card of the Cheliff basin for a good understanding of the evolution of the resource in water in the basin and that goes will serve as basis for all study of hydraulic planning in the Cheliff basin. Then, the establishment of the precipitation card of the Cheliff basin answered a direct need of setting to the disposition of the researchers for the region and a document of reference that will be completed therefore and actualized. The hydrological study, based on the statistical hydrometric data processing will lead us to specify the hydrological terms of the assessment hydrological and to clarify the fundamental aspects of the annual flow, seasonal, extreme and thus of their variability and resources surface water.

***Keywords*—**Hydrological assessment, surface water resources, Cheliff, Algeria.

I. Introduction

THE hydrographic basin constitutes the geographical unit permitting to have a global vision of the complex processes of the hydro-systems and interactions with the environment and water for human use[1]-[3].

The Cheliff–Zahrez hydrographic region, with a surface of 56 227 km^2, is situated between the Oranie region in the west and Algero is to the East. To the North and to the South, she is limited respectively by the Mediterranean Sea and the Sahara basin [4], [5].

II. General Features

Situated to the west of North Algeria, the hydrographic "Cheliff-Zahrez" region spreads on a surface of 56 000 km^2, she regroups three hydrographic basins: the Cheliff (43 750 Km^2) is the vast hydrographic basin of the north of the country, the Zahrez basin (8 989 Km^2) and the Inshore Dahra (3 201 Km^2) (Fig.1) [4], [5].

The entire study area (Coastal Dahra, Cheliff and Zahrez) falls into the class of moderate relief, probably because of the influence of the surface, which results in the attenuation of the overall terrain. However, Cheliff the downstream basin Boughzoul and Coastal Basin show morphometric characters rather special, favoring a priori surface runoff [4], [5].

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III. The Precipitations and Their Variability

Inter average rainfall in the basin varies from 200 to 600 mm; it is concentrated on the southern slopes of the mountains of Dahra and Zaccar with a maximum inter-annual average of 700 mm, while it hardly exceeds 100 mm / year in the Zahrez basin [6]-[9].

The precipitated crude rainfall on Cheliff-Zahrez basin is estimated at 19 000 hm3 / year; there are only 2000 hm3 / year because of the effect of the evapotranspiration phenomenon. The potential total evapotranspiration annually is estimated at 17 000 hm^3[4].

- A first tranche flows through the wadis in the form of runoff estimated at 1,200hm^{3}or 60% of net rainfall. There is only 500hm^3 / year which is stored in dams or 25% of net rainfall while the remaining 700hm^3 spilled into the sea.
- The second seeps into aquifers 900hm^3/year. In part against the potential of ground water that can be used are estimated at 330hm^3 as renewable water [4], [5].

IV. Water Resources

The values of the absolute annual flow (m^3/s) for the period 1968/1969-2000/2001 highlight the increased abundance of Oued Cheliff from upstream to downstream (4.39 m^3/ s in theupstreamGhribstation10.39m^3/sin Ponteba Déffluent station and23.64m^3/s in the Sidi Bel Attar station at the outfall) [4].

This gradual increase in the flow of the East to the West is consistent with the climatic data and physiographic basin. The overall balance estimated of Cheliff Zahrez to Sidi Bel Attar station is as follows:

- The average annual water precipitated (P) is estimated at 331.5mm (period 1968-2001).
- The average annual water flow (E) amounts to 40 mm.
- The flow deficit (D), estimated at 300mm, reflects a strong real evapotranspiration of about88% of precipitation.

The inter-annual irregularity of the flow can be measured by changes hydraulicity [1]-[3]. The Fig. 3 shows strong fluctuations flow from one year to another, and an abundance of flow during the period (1968-1986) and a paucity from1987 to 2001[4].

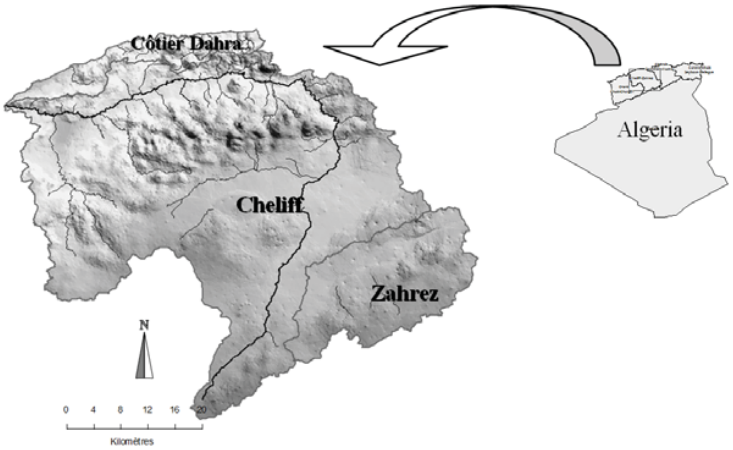

Fig. 1 The hydrographic basin of Cheliff-Zahrez [4]

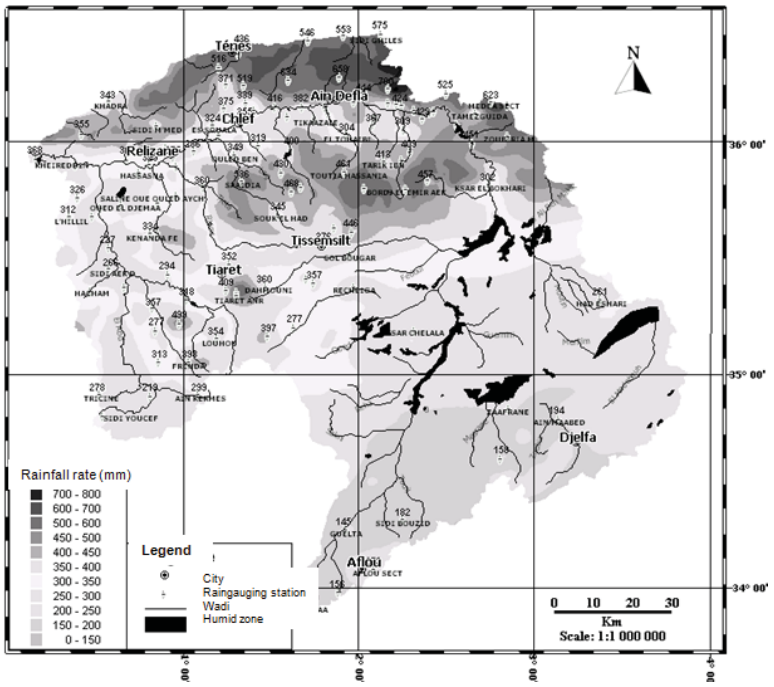

Fig. 2 Inter-yearly middle precipitation (period 1968-2001) [4]

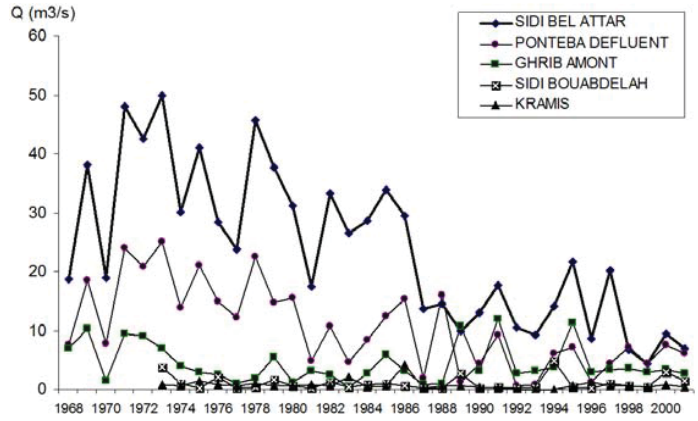

Fig. 3 Yearly variations of the modules to the different stations of 1968 to 2001

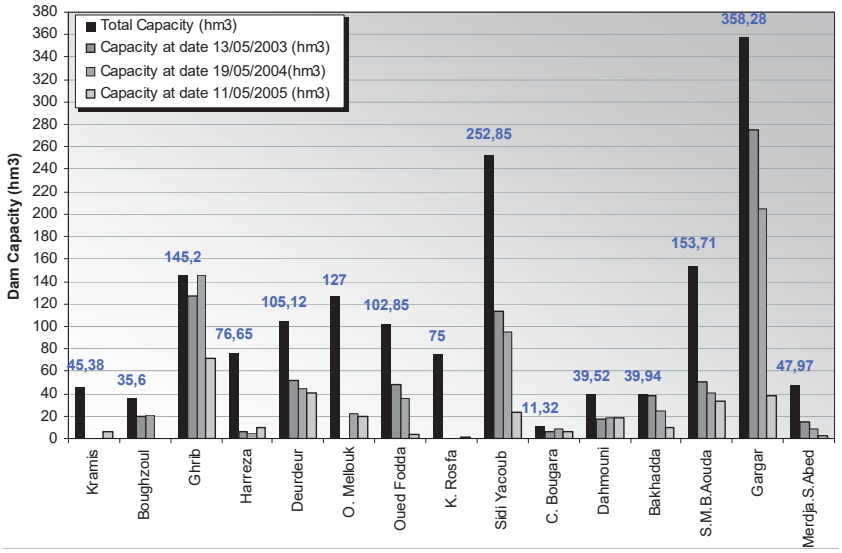

Fig. 4 State of the reserves of the dams in exploitation to the years 2003, 04 and 05

The specific flow of Dahra basins (Coastal) seems to increase from west to east, the calculated values ranging from48.99mm/year to138.58mm/ year, it is a productive zone surface water. The basins of Mina and other tributaries on the left bank of Cheliff, constitute the major part of the bottom Cheliff basin the specific flow calculated to range between 14.31 and 51.45 mm/year [4], [5]. Regarding the Middle and Upper region of the Cheliff basin represents one of the highest volumes flowing Algerian watersheds nearly 700 million m^3.

The average annual contribution is, however, a theoretical significance because of the strong inter-annual variability of surface flow [10]. This can be further confirmed by the fill rate for all dams in operation has reached 50% at the date of 13/05/2003; it reached 42% at the date of 19/05/2004 so that it hardly exceeds22%inthe following year (11/05/2005).

The resources used in surface and groundwater are estimated to 1173 hm^3 which 330 hm^3 groundwater and 746 hm3 surface water, in addition to unconventional resources treated wastewater and desalination water and are estimated at 97hm3 in 2010 [5], [10]. We cannot mobilize the entire amount of the contributions 1200 hm^3 for several reasons; technological, economic and ecological.

Data on monthly volume flow at the Sidi Bel Attar station highlight the strong water availability during the months of high water as opposed to market deficiency months of low water. The average of these monthly contributions varies between 122.76 million m3 in February and 14.22 million m3 in July (a ratio of 1 to 9) [4] (Table I).

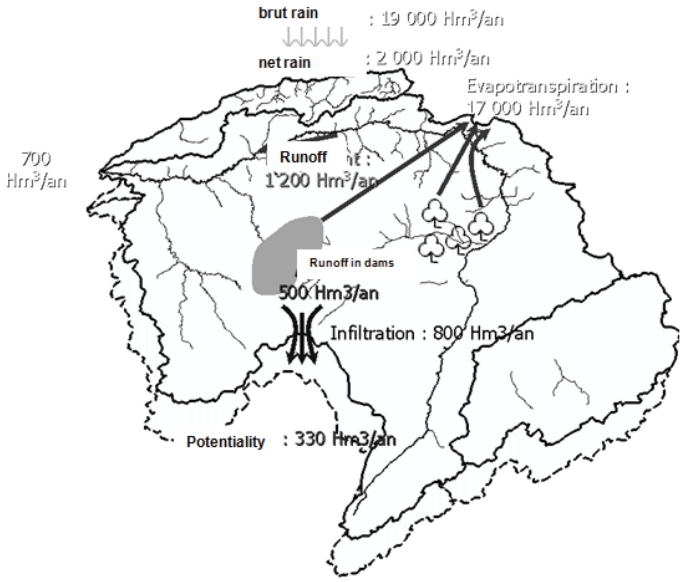

Fig. 5 Water resources in the CheliffZahrezbasin

TABLE I
MIDDLE AND EXTREME MONTHLY AVAILABILITIES IN WATER OF SURFACE TO THE UPHILL OF SIDIBEL ATTAR (1968 - 2001)

	Sept	Oct	Nov	Dec	Jan	Feb	Mars	Apr	Mat	Jun	Jul	August	Yearly average
Maximal contribution Mm^3	56,2	146,9	211,6	260,4	207,5	**567,5**	467,8	143,2	136,8	75,5	**38,5**	44,5	196,4
Middle contribution Mm^3	23,4	48,4	60,5	68,8	77,9	**122,7**	94,0	49,9	43,0	23,9	**14,2**	15,4	53,5
Minimal contribution Mm^3	0,00	0,00	0,00	0,00	**4,60**	1,23	0,02	0,16	0,00	0,00	0,00	0,00	0,50

V. CONCLUSION

In sum, the surface water resources are subject to very strong seasonal variations which go in the opposite direction of needs: the excess resources in the cold season where the needs are relatively moderate, deficit resource sin the hot season where needs, especially agricultural, are extremely high due to bioclimatic conditions of the basin.

Whatever the origin of resources and to the ever-growing needs for water, a rational exploitation and use of water are needed in both quantitative and qualitative, and should aim to maximize the value of the "water" potential. Therefore, we have:

- Develop and modernize water management.
- Mobilize new non-conventional water resources (desalination and purification).
- Install wastewater treatment systems for each industrial unit.

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