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Dabissi Noufé Djibril, Armand Tra Bi Zamble, Diallo Seydou, Emile Gnénéyougo Soro, Amidou Dao, Souleymane Diomande, Kôkôh Rose Effebi, Bamory Kamagate, Droh Lacine Goné, Jean-Emmanuel Paturel, et al.

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[1]Dabissi NOUFÉ Djibril, [2]ZAMBLE Armand Tra Bi, [1]DIALLO Seydou, [1]SORO Emile Gnénéyougo, [1]DAO Amidou, [1]DIOMANDE Souleymane, EFFEBI Kôkôh Rose, [1]KAMAGATÉ Bamory, [1]GONÉ Droh Laciné, [3]PATUREL Jean-Emmanuel, [2]MAHE Gil, [1]GOULA Bi Tié Albert, [3]SERVAT Éric.

Abstract —Water, an essential element of life, is of paramount importance in our countries, where it is increasingly scarce and threatened; we are constantly maintained by news where pollution, scarcity, flooding are mixed. As a result of current rapid climatic and demographic changes, the management of water resources by human being is becoming one of the major challenges of the 21st century, as water becoming an increasingly limited resource. It will now be necessary to use with moderation. This study is part of the project "Aghien Lagoon" (Abidjan) and its potential in terms of safe tape water resources. Megalopolis of about six million inhabitants (RGPH, 2014), Abidjan encounters difficulties of access to safe tape water due to the decline of the underground reserves and the increase the demand related to urban growth. Thus, the Aghien lagoon, the largest freshwater reserve near Abidjan, has been identified by the State of Côte d'Ivoire as a potential source of additive production of safe tape water. However, urbanization continues to spread on the slopes of this basin, while, at the same time, market gardening is developing, in order to meet the demand. If these trends continue, they will cause a strong pressure on the water resource, resulting from the urbanization and the extension of the market garden areas. Indeed, this study aims to develop under the WEAP (Water Evaluation And Planning) calculation environment, a decision support system for the management of surface water resources in the Aghien lagoon basin. The adopted methodology is based on climatic, hydrological and physical datasets, integrating a prospective vision of the water resources of the basin, extending current trends (2015) by 2050, according to alternative scenarios of the demand and the volume of mobilizable water. More specifically, the aim here is to test the ability of the WEAP model to evaluate quantitative water management scenarios, by comparing the evolution of the demand with that of supply in terms of water availability.

Index Terms— Surface water resources, WEAP model, Sustainable management, Aghien lagoon, Côte d'Ivoire.

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1 Introduction

Water, an essential element of life, is of paramount importance in our countries, where it is increasingly scarce and threatened. For several decades, we are constantly maintained by news that mixes pollution, drought, floods [1]. In addition, inadequate water supply infrastructure in most developing countries has exacerbated this problem [2]. As a result of rapid climatic and demographic changes, the management of water resources by human societies is now becoming one of the major challenges of the 21st century.

Indeed, Côte d'Ivoire as a whole and the Aghien lagoon basin in particular, are confronted in recent decades with a recurring drought; this is characterized by the decrease of rainfall accumulations and the modification of precipitation regimes [3], [4], [5]. Generally lower than the evaporative demand (ETP), during nearly half of the year, these falling rainfall totals cause a high sensitivity to rainfall deficits; because water stocks (soils, groundwater, surface water) can not always buffer the deficit periods. Thus, any deficit, even short in the rainy season, is crucial for the replenishment of rapidly depleting stocks at the surface and sub-surface. And given the unequal capacity of soils to store water, these rainfall variations are not always without consequences on the ecological, agronomic and hydrological responses [6].

This decline in rainfall, which began in the Gulf of Guinea in the late 1960s, intensified during the 1970s and 1980s, before experiencing some remission in the 1990s. However, the District of Abidjan located in southern Ivory Coast, an area considered one of the most humid in the country, still fails to meet the water needs of its ever-growing population. Indeed, megacity of about six million inhabitants (RGPH, 2014), growing at a rate of about 3% per year, the city of Abidjan and its suburbs are supplied with drinking water from the groundwater of the Continental Terminal. But this source proves to be increasingly insufficient, because of the proven decline in the volume of rainfall and the concomitant growth of the population. The use of additive sources has become an imperative for decision-makers in charge of water resources. The Aghien Lagoon, the largest freshwater reserve near Abidjan, has been identified by the Ivorian State as a potential source for the production of safe tape water. However, urbanization continues to expand in this basin, in parallel with market gardening and pastoral activities, to respond favorably to urban demand. If these trends continue, they will exert a strong pressure on the water resource. However, supply/demand adequacy in water is one of the major challenges in a District like Abidjan where water management has not always been the most appropriate.

Thus, in face of this issue, whose stake is part and parcel of the SDGs (Sustainable Development Objectives), we proposed to test the WEAP model (Water Evaluation and Planning System), with a view to achieving a management plan for a water resource under climatic and anthropic constraints. The adopted methodology is based on hydroclimatic and physical datasets, taking into account a prospective vision of water availability. This approach extends the current trends (2015) by 2050, incorporating alternative scenarios for changing water demand. More specifically, it is a question of testing the ability of the WEAP model to evaluate quantitative water management scenarios, by comparing the evolution of the supply to that of the water demand of the basin.

2 INTRODUCING THE AREA STUDIED, MATERIAL & METHODS

2.1 Area of the Study

The Ivorian basin of the Aghien Lagoon is located between 5° 21 'and 5° 28' N, and 3° 49 'and 3° 58' W (Fig. 1).

It covers an area of 351 km² and a perimeter of 181 km. The index of compactness (Kc) calculated on the order of 2.71, determines its elongated shape; the specific height difference (D) of 100 m, allows to conclude on a rather tormented relief. The average slope index (Ip) is 1.15 m/km, while the equivalent Rectangle Length (L) is 86.44 km. The maximum, minimum and average altitudes are in the order of: 137 m, 12 m and 76 m, respectively. The Aghien lagoon itself covers an area of 20 km² for a perimeter of 41 km and a total capacity of about 25 km³. Annual contributions are mainly provided by two tributaries located upstream of the basin: Bete and Djibi (Fig.1).

Due to its location in the south-east of the country, the Aghien basin undergoes an equatorial type of transition, characterized by four seasons [7]. This climate is fairly representative of rain forests (now highly degraded) that extend south below the isohyet 1600 mm. From a geological point of view, the area straddles the crystalline basement to the north and the sedimentary basin to the south [8]: the soils of the sedimentary basin consist mainly of clay sediments, while those of the basement zone consist of arkose sandstone, shale and grauwacks, associated with granitoid intrusions. At the human level, the basin includes part of the District of Abidjan, including the sub-prefecture of Brofodoume and the communes of Abobo, Bingerville and Anyama (Fig. 1). The demand for water is broken down into three categories: domestic water demand (DED), agricultural water demand (DEA) and livestock water demand (CED). Given its agricultural vocation, this basin is planted with rubber, palm oil, corn and banana, associated with market gardeners (eggplant, okra, onion, tomato, cabbage, *etc.*). We note here and there, pig farming, sheep and poultry, or the presence of some fish ponds. Thus, it is an area under pressure both in terms of water resources and arable land. Several projections of population growth at a rate of about 2.61% per annum are planned with the consequent increase in domestic water requirements.

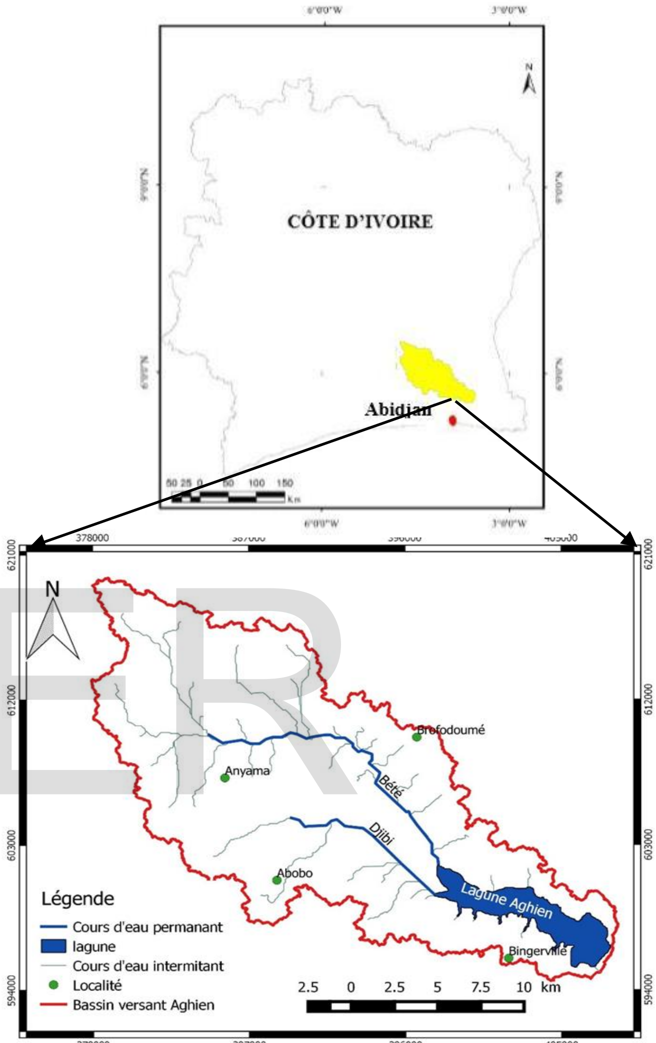

Fig.1; The situation of the Aghien lagoon basin in Côte d'Ivoire and the main associated localities

2.2 Material & methodes

2.2.1 Data used under WEAP

The approach adopted is based on the construction of a cartographic database (BD) (3 layers): climatic (6 rainfall stations), hydrological (6 hydrometric stations), and physical (2 tributaries), covering the study area.

2.2.1.1 *Hydroclimatic data*

The daily time step simulation period runs from 2015 to 2050. On this basis, the hydrological and climatic variables used as WEAP modeling parameters consist of precipitation, temperature, evapotranspiration and runoff data. These hydro climatic datas come from the "*Aghien Project*".

2.2.1.2 *Demographic data*

The demographic data derive from the last three General Censuses of Population and Housing (RGPH) of 1988, 1998 and 2014. They were collected from the National Institute of Statistics (INS) and presented here by locality (Table 1). However, demographic data from later years will be extrapolated in a linear fashion. Also, the average annual water demand of the population has been calculated on the basis of the estimate of the Master Plan for Integrated Water Resources Management [9] which set the unit consumption at 50 l/d/p.

Table 1; Population and annual growth rates calculated by location

Localisations	Population in1998	Population in 2014	Annual growth rate in 2014
Abobo	638237	1 030658	3,2
Bingerville	56356	91319	3,2
Anyama	142679	148 962	0,3
Brofodoume	13191	15 842	1,2
Total	**850463**	**1 286781**	**Average : 2,62**

Source : RGPH, 1998 and 2014

2.2.1.3 Agricultural and Pastoral Activities Data
2.2.1.3.1 Pastoral sector

Livestock farming remains a relatively important activity in the Aghien basin. It is a semi-extensive breeding of sheep, goats, pigs and especially poultry. The water supply of these flocks is done directly on surface water resources. The rules governing livestock water requirements theoretically set at 5 l /d/ head for small livestock and 25 l/d/ head for livestock (Table 2 & 3). It is on this basis that the water demand of the flocks was therefore estimated (Table 3)

Table 2; Daily theoretical water requirements by type of livestock

Types of livestock	Cattle	Ovine	Goat	Porcine	Poultry
Theoretical water needs (m^3/day/head)	0,025	0,005	0,005	0,007	0,0001

Source: [10]

Breeding type	Number of animal	Water requirements in m^3/ day
Cattle	1203	30,075
Ovine	40	0,2
Goat	10	0,05
Porcine	525	3,675
Poultry	20883	2,0883
Total	**22661**	**36,0883**

Source: In situ measurement campaign (Aghien Project, 2015)

2.2.1.3.2. Agricultural Area

These data are derived from an in situ measurement campaign conducted by the "Aghien Project". Agricultural sites in the basin are generally cultivated with partial control of water on small plots (0.5 to 1 ha). The irrigated areas and the volumes of water consumed in each sub-basin are presented in Table 4.

	BV Aghien		BV Bété		BV Djibi	
	Ha	Water consumption (m^3/an)	Ha	Water consumption (m^3/an)	Ha	Water Consumption (m^3/an)
Banana tree	40	365 000	40	365 000	00	00
Vegetable grower	85	297 500	35	122 500	50	175 000
Total	**125**	**662 500**	**75**	**487 500**	**50**	**175 000**

Source: *Projet Aghien*", 2015

2.2 Methods

2.2.1 Application of the WEAP model to the Aghien lagoon basin

The application WEAP is to choose a year "accounts current" which serves as a base year, also considered one step timing of the model. Then, a base case is developed to simulate the extension of the trend, without changes "as is". Thus, 2015 is chosen as year "accounts current" Associated with information relating to data availability (offers), sites query (requests) and socio-economic (population, state activities agro-pastoral) (Fig. 2). A base case over the period 2015-2050 was established from the "accounts current", in order to simulate the evolution of the Basin, without interventions. Then we have established scenarios type "what if?" That alter the base case, thus allowing to assess the scale of the Basin, the extent to which developments considered uses of water could be compatible with changes in the needs unit and infrastructure agro pastoral [11]. The basic assumptions are constructed from the "accounts current", in order to represent the factors that affect demand and supply. Scenarios built on this basis cover questions such as: population growth, climate change, the needs increased ecosystems, etc. [12]. A satisfaction index of water demand (ISDE) is designed (Fig. 2), in order to confront the evolution of availability to that of water demand, in a context of population growth and climate change fast. This indicator on the part of the application which could be satisfied in time, evolves between 0 and 1:

ISDE <1, the request is not satisfied;
ISDE > 1, the request is fully satisfied;
ISDE = 1, the supply and demand balance;
1-ISDE is the part of the application which remains to be met.

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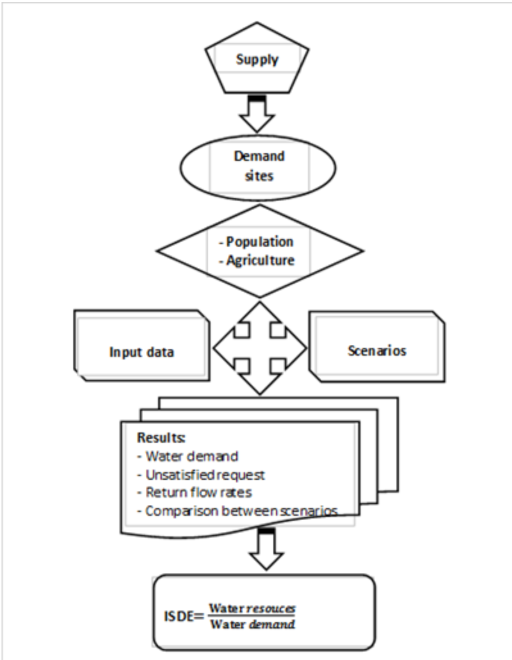

Fig **2;** Modeling steps under WEAP (*source*: [13])

2.2.2. Project Creation

The project is created in important first in the schematic view of the model, the contour Basin and River system to file format shape (ArcView), then sites request, tanks (basins), links transmission and links round-trip are finally digitized (Fig. 3).

Thus the project includes the following:

- the sites of demande (3) : the sites of householders, the sites of planting and the sites of breeding ;
- the Rivers (3) whose flow is simulated by the WEAP model ;
- the sub basins (3) which introduced climate data (precipitation, ETP, temperature) ;
- the area and the cultural coefficient (kc);
- the transport links (2) for the water sources transit ;
- the water flows (3) of the sites which part returns to Rivers, another for consumption.

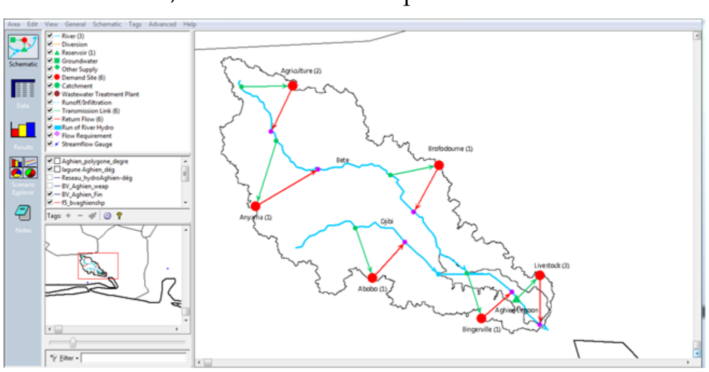

Fig. 3; Aghien watershed Project management under the WEAP Model environment

2.2.3. Fixing the general settings model

2.2.3.1. Settings time

The evolution of the "account current" allows calibration model. Base year of this study is 2015, with a time reference annual.

2.2.3.2. Creation of assumptions and scenarios

The modeling of water demand is based on the distribution of priorities whose allocation is specified in the table 6.

Table 6: Priorities in the distribution of water demand

Types of demand	Priorities
Domestic	1
irrigation	2
livestock	3

The scenarios are based on data tables 1 to 5. The future trends are projected according two scenarios compounds a Scenario "Reference" (« SR ») and a Scenario "Growth" strong (« SC »). The « SR » is based on historical data prior to 2015. In the « SC », growth rates are based on the forecast management plan integrated water resources in Côte d'Ivoire [9] and other structures such as the WFP (World Food Program), INS (National Institute of statistics), *etc.*

2.2.3.3. Creation of the scenario "method of the hydrological year"

The aim is to define different regimes climate (very dry, dry, wet, very wet, normal), and compare with a normal year by giving a value between 0.7 to 1,45 each type of climate (table 7); this makes it possible to assess the impact of the climate change in water resources (precipitation, groundwater recharge rates, etc.), related to the user needs. The simulation software not recognizing that numeric values, each type of climate corresponding to the year, must wear a numeric value (table 7), so that the software can proceed to the modeling.

Table 7: Definitions of climates types

Type of climatic years	Very dry	Dry	Normal	Humid	Very humid
Corresponding Figures	0,7	0,8	1	1,3	1,45

2.2.3.3. Calculation of water demand

Water demand by branch (D_b), in cubic meters, is calculated by the formula:

$$D_b = L \times R \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

With:
L = Level of the branch activity,
R = Ratio of water consumption.

The activity level of the branch (L) corresponds to the area expressed in m², ha, km² or irrigated land ratio; specific pro-

portions of population (human or animal). The water use ratio (R) is the rate of water use for the application site.
The water demand by site (Ds) is expressed as follows:

$$D_s = \sum D_b \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$

The overall water demand (Dg) of the project is given by:

$$Dg = \sum Ds \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

In the end, all of these formulas are used in the WEAP 21 model.

3 Results & discussion

The results are analyzed in three parts in order to reveal the different facets of the demand: comment on simulated sectoral demands according to the scenarios, analysis of the overall demand and comparison between the various scenarios.

3.1 Modelisation results

3.1.1 Sectors Analysis results

3.1.1.1 Domestic water demand (DED)

The results of the modeling show that the domestic water demand (DED) estimated in 2015 at 27.97 Mm^3 for Abobo, according to the « CR », will tend to triple by 2050, given the demographic weight of this locality. For the same period and for the same scenario (CR), the water requirements of the less populated localities of Anyama, Bingerville and Brofodoume increased from 4.04 Mm^3 to 4.49 Mm^3, from 2.48 Mm^3 to 7 M^3 respectively ; 46 Mm^3 and finally, from 0.43 Mm^3 to 0.65 Mm^3. It can thus be seen that unlike the localities of Anyama and Brofodoume, where there is a slow evolution of the demand for domestic water (DED), only the locality of Bingerville will triple its needs by 2050 (Fig. 4A). In the strong SC, the same trend observed previously, moves to an exponential evolution, even if Abobo and Bingerville seem to know a slight slowdown; because the estimated demand of 4.04 Mm^3 for the locality of Anyama and 0.43 Mm^3 for Brofodoume practically tripled between 2015 and 2050 (Fig. 4B). The trend in domestic demand for water therefore remains the same for both scenarios.

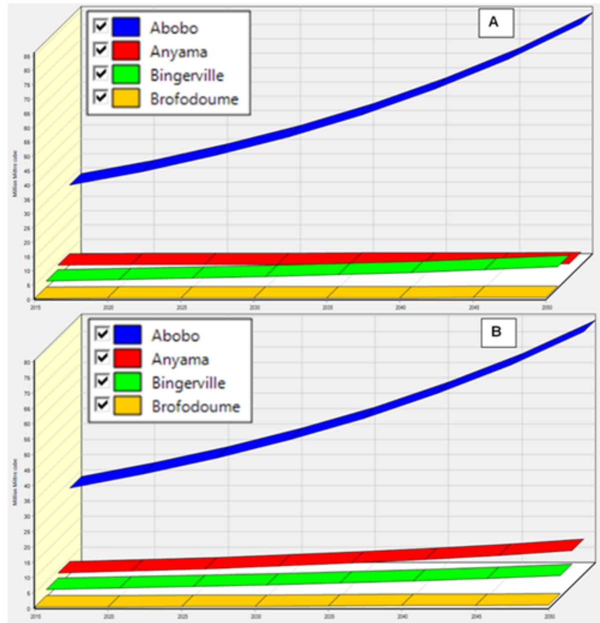

Fig. 4; Domestic water demand by locality, for scenarios "SR" (A) and "SC" high (B).

In addition to the increase in domestic water needs, livestock water and irrigation needs are added, and even assuming that irrigated areas and livestock size should not increase; because these two sites of demand are supposed to slow down their extension in favor of the galloping urbanization. Also, in addition to anthropogenic pressures on the water resource, it suffers the effect of climate change.

3.1.1.2 Agricultural Demand for Water (DEA)

The study of the evolution of water consumption for agriculture aims to find a relationship between the evolution of irrigated areas and the evolution of water withdrawals. The simulation results showed that agricultural water requirements will increase in the coming years for each scenario and for each agricultural sector (Fig. 5); they vary between 40 and 80 Mm^3, whatever the scenario and the agricultural sector. In other words, the demand for irrigation water would be doubled over the study period (2015-2050) (Fig. 5).

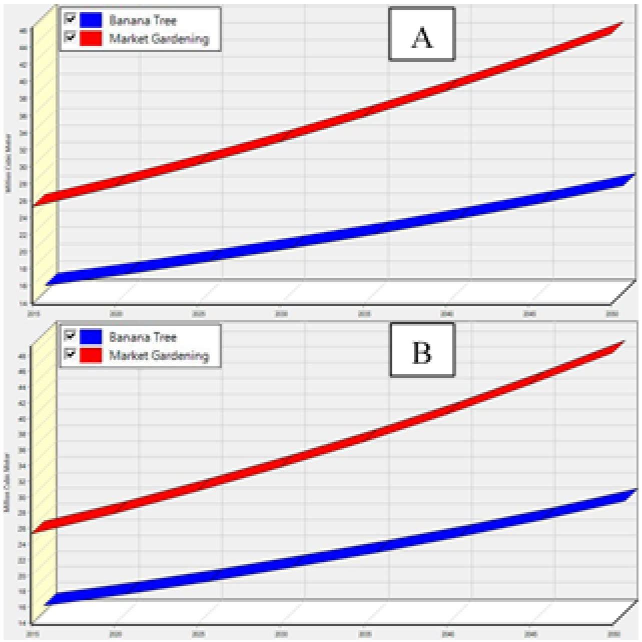

Fig. 5; Agricultural water demand (AED) for the "SR" (A) and "SC" strong scenarios (B)

However, against all odds, the needs analysis between 2016 and 2050 showed the intervention of a slight modification in the basin: the progress of urbanization, inducing a constant level of water needs. However, in allocation priorities, the demand for water for agriculture ranks second to domestic needs. It is a relatively important part of the mobilized water resources which is therefore intended to satisfy irrigation water needs, with an annual volume of around 13 Mm³. Thus, despite the constant level of irrigated areas, the preponderance in terms of water volumes allocated to irrigation is due to the increase in agricultural activity, encouraged in recent years by a strong urban demand for food products.

3.1.1.2 Livestock water demand (DEC)

It cames out that according to the estimations of the volume of water allocated to the livestock sector, cattles are the largest users of water, followed by the poultry sector.

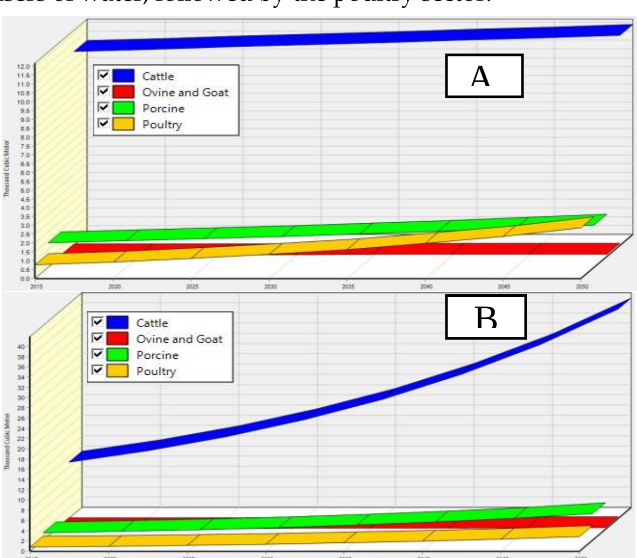

Fig. 6; Livestock water demand for the "SR" (A) and "SC" scenarios (B)

The water demand of the cattle herd follows a linear trend in the « SR » with values around 10,980 Mm³ in 2015 and 12,890 Mm³ in 2050 (Fig. 6). In the same scenario, the water needs of the poultry sector explode with values around 760 Mm³ in 2015 to 10 800 Mm³ in 2050. In the « SC », an exponential trend is very marked for cattle, with values reaching 11 000 Mm³ in 2015, but having a tendency to quadruple by 2050 (Fig. 6); poultry follows with values around 760 m³ in 2015 and 11,000 m³ in 2050.

3.1.2 The overall water requirements of the different basin demand sites

Demand for water rose from 75 Mm³ in 2015 to 175 Mm³ in 2050, in the "growth" scenario for all sectors of activity. Moreover, since 2015, we have noted that domestic water demand, although one of the highest allocation priorities, has evolved below the level of its needs, until 2038.

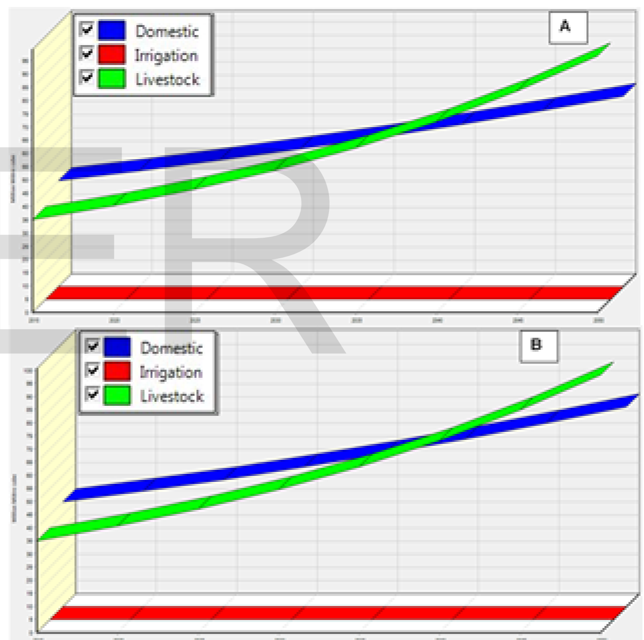

Fig. 7**;** The overall water demand of the sites in the Scenarios "SR" (A) and "SC" (B) (2015-2050).

Moreover, whatever the scenario and the period, there is a great disparity between the water demand of the agricultural and pastoral sectors: the water needs of livestock are insignificant in the face of agricultural demand for water. Fig. 7 above shows the evolution of needs for each user for the "SR" & "SC" scenarios. The water demand for all "SC" of the sites by 2050 amounts to 174.61 Mm³, distributed as follows: 98.27 Mm³ for domestic use, 76.28 Mm³ for irrigation and 0.06 Mm³ for the livestock.

3.1.3 Scenario "Method of the Hydrological Year"

Since the purpose of this study is to propose a method for managing water resources, it is necessary to take into account population growth and possible changes in the climate; hence the creation of the "Climate Change" Scenario (« SCC »), inherited from the "SR" that applies the "Method of the Hydrological Year", and the "SC". Thus, the three curves that evolve into sawtooth (Fig. 8) do not begin to differentiate until after 2037; this trend is due to random changes in climate during the study period.

Indeed, when a year is wet, there is a sharp drop in unmet demand (« DNS ») due to an increase in the availability of water; when a year is dry, however, the unmet demand increases (Fig. 8). For the « SR », the flow is constant; because this scenario is based on the assumption of a stable (normal) climate regime for the future years. For « SC », the water slide that will flow in 2050 will reach a value around 62.82 Mm^3 (Fig. 8), taking into account possible climate variations. As well as taking into account population growth, the demand that will be expressed by 2050 will reach 94.76 Mm^3; a deficit of 31.94 Mm^3. In the face of high population growth, water resources become highly vulnerable to climate change. The next step in using the "Hydrological Year Method" is the creation of a sequence of climatic variations for the study period; for each year of the period, one of the categories of climate is assigned: the period 2025-2031 constitutes a slice of very wet years, while the period 2040-2047 consists of dry to very dry years, except the years 2042, 2043 and 2046. Unmet demand (DNS) varies almost parallel to climatic variations (Fig. 8). During wet or very humid years (2025-2031) when there is an increase in precipitation, the DNS is practically non-existent (Fig. 8). The opposite occurs during the normal years, dry to very dry (2032-2050) where the rather weak precipitations and the larger deficits, reach 27,1 Mm^3 in 2050. Thus, a weak climate change directly influences the water supply, with strong "SR" and "SC" scenarios (Fig. 8). For scenarios "SC" strong and "SCC", the « DNS » reaches 31,94 Mm^3 in 2050.

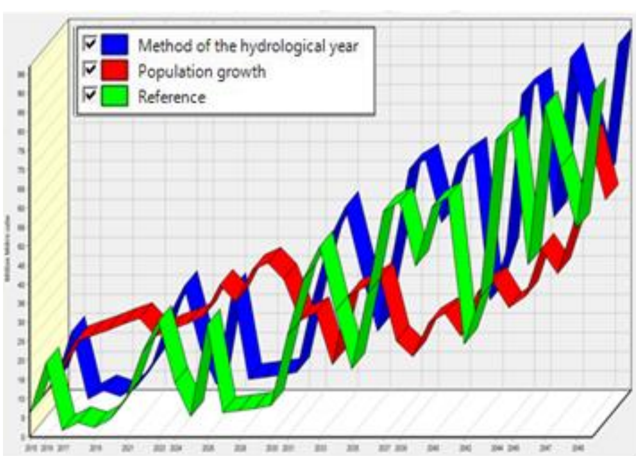

Fig. 8; Projections by 2050 of «Global demand not satisfied" in "SR", "SC" and "SCC" scenarios.

3.1.4. Assessment of supply and demand management of water resources in the basin

Figures 9A & 9B show incoming flows for each demand site, as well as outgoing flows and associated consumption levels. The scenarios used to evaluate these results are the "SR" and the strong "SC". The flows consumed consist of:

- the flows related to domestic needs;
- flows related to irrigation;
- livestock consumption rates.

Thus, the flow management report is written as follows:

$$Q_e = Q_s - Q_u \cdots\cdots\cdots\cdots\cdots\cdots (4)$$

With:

Q_u: Flows leaving the outlet of the basin;
Q_e: Incoming or outgoing flows from all sources;
Q_s: Flows or volume of water consumed by each branch of use.

Whatever the scenario, it is noted that incoming flows, mainly from the Bété, Djibi and Aghien supply sources, continue to increase until 2050 (Fig. 9A & 9B) ; this could essentially be explained by a sharp degradation of the land cover due to the amplification of agricultural activities in the basin. For the « SR », incoming flows will reach the value of 119.096 Mm^3 in 2050. Conversely, the flows or volumes of water consumed will be of value of approximately 64.415 Mm^3, while the flow outgoing the system will be of a value of approximately 64.415 Mm^3, while the flow outgoing the system will be of the order of 54.681 Mm^3 (Fig. 9A). For the strong « SC » scenario, incoming flows will reach a value around 120.172 Mm^3 by 2050, while the flows used (consumed by the demand sites) will be of the order of 65.156 Mm^3. The outflow to the outlet of the basin is about 55.016 Mm^3 (Fig. 9B). This outflow represents the unused flow remaining in the pond where it is subsequently evapored or exported elsewhere. At last, the management balance (supply/demand) of the water in the basin under study is generally positive; we will not expect a water deficit by 2050. But changes in the climate regime are possible; therefore, it will be better to adjust supply on demand, under the context of integrated water resources management in the basin.

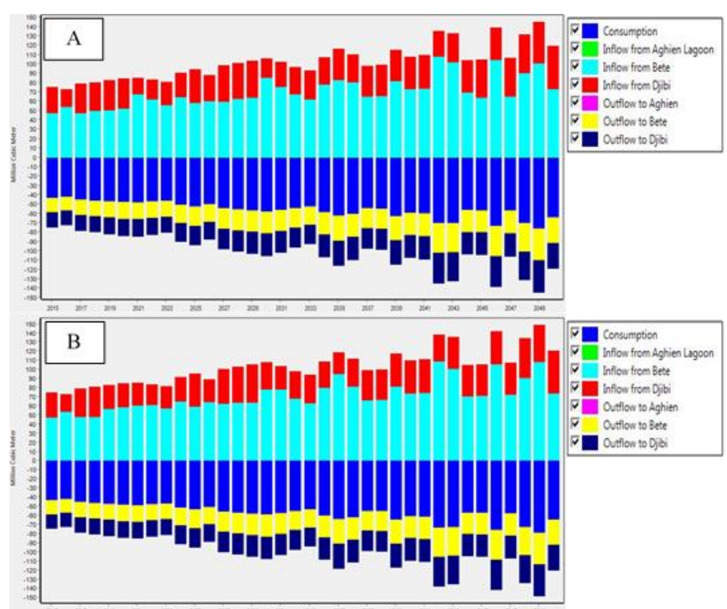

Fig. 9; The flows of demand sites in 2050 for the scenarios« SR » (A) and « SC » (B).

4. Discussion and perspectives

Modeling the water demand by 2050 has shown that the overall needs of the Aghien basin will increase regardless of the scenarios. By 2025, they are already estimated respectively at 25.2 Mm^3 and 91.7 Mm^3 in the scenarios "SR" and "SC" strong. These values will tend to double, 25 years later. This could pose the problem of water supply, especially in a context of rapid population growth and climate variability [12], [14] have shown in a similar study in the Olifant Basin (South Africa) that the different types of use (domestic, agricultural, pastoral, etc.) make the management of water resources very complex. This same observation is made by [15] on the management of water resources in the Malagasy basin of Morondava.

4.1 Global Analysis

Except for the pastoral sector, the overall water demand for the various sectors of activity in the Aghien basin increases at the same rate from 2015 to 2050 for the "SR" and "SC" scenarios; this increase is due to a population growth rate that will double by 2050. Figure 7 shows the trends that emerge by sector according to the scenario. The results obtained are, according to the two scenarios, 75 Mm^3 for the year 2015 and 169 to 175 Mm^3 for 2050.

Moreover, with the exception of the pastoral sector, the results of the unmet demand (DNS) for the other sites, show that the deficit was mainly observed throughout the simulation period for the scenarios "SR" & "SCC". This deficiency is mainly due to strong domestic and agricultural demands in a context of climate change and rapid population growth. In other words, the mobilized water resources are almost limited and the supply does not improve with the increase of the population and irrigable land. Thus, the DNS for the "CSC" starts from the year 2037 with rather low values, but increasing regularly from 4 Mm^3 in 2041, to 18 Mm^3 in 2045, to reach 19 Mm^3 in 2050.

4.2 Comparison between scenarios

The results of the simulation show that the "SR" is a passive scenario; because no action has been taken to deal with possible changes in the climate, the increase of the population and the extension of irrigable land. On the other hand, the "SC" and "SCC" scenarios showed decent results on the satisfaction of the demand. The comparison between Scenario III "SCC" and Scenario II "SC" may help to select the best scenario to apply in order to preserve water resources from mismanagement and ever-increasing demand. If Scenario III is applied against Scenario II, water demand can be reduced by 71.82 Mm^3 in 2015 and by 56.01 Mm^3 in 2050.

The domestic water DNS is important for scenario II compared to scenario III; the difference in the DNS between these two scenarios is 21.85 Mm^3 in 2025 and 57.98 Mm^3 in 2050, in all the localities of the basin. With regard to the agricultural water DNS, the difference between the two scenarios is of the order of 10, 89 Mm^3 in 2025 and 24.72 Mm^3 in 2050.

5. CONCLUSION

As part of this study, a decision support system is developed to model water resources and uses, assess the management balance (supply/demand), and analyze the situation future water resources of the Aghien lagoon basin, according to different alternative scenarios. WEAP is the appropriate software. Indeed, the WEAP model is based on the available data during the reference period to simulate development and resource management scenarios. It periodically calculates (days, months, years) the conservative volume balance of the inputs and outputs, by solving an iterative algorithm of linear programming whose objective is to maximize (minimize) the satisfaction of the requests (the allocation deficits) in water in the different sectors under constraints to meet the needs in order of priority [16].

Thus, the data provided (here) by different institutions (INS, MINAGRI, Aghien Project, etc.) constituted the physical, hydrological and climatic database. The WEAP model is used as a calculation and hydraulic simulation tool. WEAP has enabled us to estimate until 2050, the five-year needs of the Aghien lagoon basin by sector of application. According to the order of priority assigned to each type of demand, the domestic sector ranks first with 25.2 Mm^3 and 91.7 Mm^3 in 2025, respectively in the "SR" and the "SC" scenario (most likely in because of the increase in agricultural activities due to population growth rates in the basin). This sector is followed by agricultural water demand estimated at 39.5 Mm^3, according to the strong "SC". Livestock demand is insignificant due to the underdevelopment of this sector in the basin. It is kept constant in both allocation scenarios, with a value of 1.4 Mm^3. All trends should more than double by 2050. These results can already be used as indicators for decision-making. In addition, the implementation of an integrated water resources management plan for the basin is possible in the current dual context of uncontrolled urbanization and rapid climate change.

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