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**The disposition of water supply and demand in Cameroon:
What potential for what standard of living conditions?**

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Abstract

Aim/purpose – This paper attempts to appraise the potential of water resources for Cameroon and the standard of living conditions confronting people in the country.

Design/methodology/approach – A simple descriptive method of data analysis is adopted using analytical tools such as percentages, tables, and means to achieve the objectives of the inquiry. Data for the study were generated from personal observations in one hand and collected from water resources literature, on the other hand.

Findings – With the help of the data gathered, the paper establishes that despite the existence of abundant water resources in Cameroon the standard of living conditions of people with respect to basic needs of survival such as drinking water, improved sanitation services, and electricity supply is far below expectation.

Research implications/limitations – The main implication of the study is that in spite of the surplus volume of water resources (325.96 km³ or 95.12% of annual total water resources) endowment in Cameroon, the population benefits marginally from it due to the mismanagement of resources and misplacement of priorities as obtained in most sub-Saharan African countries. One limitation of this study is that the use of limited primary data in the investigation offers no room toward establishing the extent of water resources allocation to the various users of water in the country.

Originality/value/contribution – The paper suggests that the government of Cameroon should encourage the population to run community basic social services projects and subsidize the activities of such ventures in kind through technical assistance or in cash.

Keywords: household, water, sanitation, electricity, welfare.

JEL Classification: D10, I31, Q1, Q25, Q40.

1. Introduction

Toward the last decade of the 20th century, governments across the globe promised the provision of basic social services to all by the year 2000. This presupposed the provision of drinking water, improved sanitation services, electricity, transport, food, shelter, employment, education, healthcare, and peace to all by December 2000 [Inter-Agency Commission (IAC) 1990], which could have portrayed 2000 as the year of victory against the misery of man on earth. Unluckily by December 2000, this ambitious plan for humanity has not materialized as the living conditions of man on earth became more miserable afterwards. Nonetheless, the failure of this gigantic project educated world leaders to commit their political will to more realistic projects in the future.

As a result, the millennium development goals (MDGs) agenda was drafted to attempt a 50% reduction of the misery confronting humanity toward accessing basic survival needs such as drinking water, education, electricity, clean environment, decent jobs, and healthcare by December 2015 [European Commission (EC) 2013]. Although some successes have been recorded sporadically on the target elements of MDGs agenda across the globe, still a lot needs to be done especially in sub-Saharan Africa where there is little to show about this venture.

Cameroon has much water resources [Central Intelligence Agency (CIA) 2012; Oumar & Tewari 2013] that can be harnessed to enhance the living conditions of people by offering them adequate access to drinking water, improved sanitation services, and electricity supply. Yet in 2011, an assessment of people's access to drinking water [World Bank (WB) 2013a] and improved sanitation services [WB 2013b] on 5 African countries regarded as leading economies in their respective economic regions revealed that Cameroon is lagging behind Egypt by 20% and trailing South Africa by 12% in people's access to drinking water, in one hand and Egypt leads Cameroon by 15% and South Africa leads Cameroon by 21% in terms of people's access to improved sanitation services, on the other hand.

Furthermore, with 48.70% of people having access to electricity in 2009, Cameroon occupies the 55th position in the world in a cohort of 87 countries surveyed and assumes the 10th position after Libya (99.80%), Egypt (99.60%), Tunisia (99.50%), Mauritius (99.40%), Algeria (99.30%), Morocco (97%), South Africa (75%), Ghana (60.50%), and Nigeria (50.60%) among the 33 African countries examined even though it assumes the 5th position among the 25 sub-Saharan African countries reviewed [WB 2013c].

Moreover, a careful examination of the living conditions in Cameroon from the angle of supply of drinking water, improved sanitation services and electric-

ity to people is repulsive because the recurrent scenarios as regards the provision of these basic social services are painful. Drinking water from the taps does not flow regularly and always there are long queues in front of water supply taps whenever water is available. Sometimes people travel long distances in cities in the search of drinking water to avoid long queues waiting time. At worst, people make use of water from rivers to perform domestic activities. Also, it is common to see drinking water flowing and wasting into the nature for weeks in the quarters due to unattended tap leakages in cities across the country. As regards improved sanitation services, it is usual to come across people easing themselves in open air spaces and dumping waste materials anyhow on the streets in cities across the country. Besides this, the distribution of electricity to users is not regular in the country as users of electricity hardly enjoy continuous supply of the service for a week. As a result of this, some economic operators in the country have acquired standby electric power generators that they switch on to pursue their economic activities in situations of electric power supply failure, thus creating noise and air pollution in the neighborhood. Another dilemma facing users of electricity in the country is the payment of factitious electricity bills due to wrong computation of units of electricity consumed from the electricity supply company – The Applied Energy Systems – “Société Nationale d’Electricité” (AES-SONEL)/ENEO-Cameroon.

These occurrences are witnessed in a country full of natural resources that can be harnessed to secure comfortable living conditions to people. Therefore, a series of questions to ponder on can be formulated as follows. One, what is the potential of water resources availability in Cameroon? Two, what is the extent of quality water resources availability in Cameroon? Three, what is the level of people’s access to basic social services such as drinking water, improved sanitation services and electricity supply in Cameroon? In other words one may wish to know the extent of comfort offered to people in Cameroon with the amount of natural resources available in the country. Perhaps the people of Cameroon are less aware of the availability of these potentials to make them claim for a better provision of basic social services like drinking water, adequate sanitation cover, and regular electricity supply in the country. The exposition in this paper may trigger initiatives for claiming better living conditions by the people in the country. This paper is an attempt to inspire such a claim by educating the people about the volume of water available for them and how much of it is actually offered to them. Thus, the main objective of this paper is to detail the disposition of water supply and demand in Cameroon. Specifically, it envisages to:

- Appraise the potential of water resources for Cameroon,
- Analyze the quality of water resources in Cameroon,

- Assess the level of people's access to basic social services in Cameroon, and
- Make suggestions on how to improve the living conditions of the population in the country.

The rest of the paper is organized as follows. Section 2 explores the review of literature, followed by an explanation of the methodology in Section 3. The results and discussion are presented in Section 4, while the conclusions of the paper are given in Section 5.

2. Literature review

In order to establish whether or not a place or country has sufficient amount of water resources, there is the need to subject the volume of water resources of the area to some mathematical rigor as suggested by experts in the field of water resources management. Some of the criteria used in that perspective are explored in the following paragraphs.

Falkenmark, Lundquist and Widstrand [1989], Roudi-Fahimi, Creel and de Souza [2002], and the World Bank (WB) [2007] suggested the threshold of 1700 cubic meters (m^3) of annual per capita water as the universal minimum volume needed to effectively undertake all economic ventures in an economy. The annual per capita water of a country determines when that country can be classified as water surplus, water sufficient, water stressed, or water scarce. With the per capita water availability approach, Brouwer and Falkenmark [1989] argue that any area with annual per capita water falling below $1000 m^3$ is a water scarce area, while a region with annual per capita water ranging between $1000 m^3$ and $1700 m^3$ is a water stressed area. Besides, an area whose annual per capita water stands at $1700 m^3$ is a water sufficient area, while an area with annual per capita water above $1700 m^3$ is a water surplus area.

Another way of assessing the water availability status of an area is by examining the extent of water vulnerability of that area. Kulshrestha [1993] proposes the combined water availability and rate of use criterion with 4 distinct scenarios to determine the extent of water vulnerability of an area and explains with the first scenario that if the annual per capita water supply is less than $1000 m^3$ and the rate of use of available water supply is less than 40%, the area qualifies as marginally vulnerable or water sufficient, but if the rate of use of available water supply lies between 40% and 60% with the same annual per capita water supply, then the area is regarded as more vulnerable or water stressed. Next, if the rate of use of available water supply oscillates between 60% and exactly 80% or above with an annual per capita water supply less than $1000 m^3$,

then the area is classified as most vulnerable or water scarce. Outcomes similar to the first scenario where the annual per capita water supply is below 1000 m³ are obtained with the second scenario when the annual per capita water supply ranges from 1001 m³ to 2000 m³. The third scenario explains that when the annual per capita water supply varies between 2001 m³ and 10 000 m³ and the rate of use of available water supply is below 40%, the area is categorized as non-vulnerable or water surplus but when the rate of use of available water supply falls between 40% and 60%, the area becomes marginally vulnerable or water sufficient. Furthermore, when the rate of use of available water supply fluctuates between 60% and 80%, the area is rated as more vulnerable or water stressed and it transits to the status of a most vulnerable or water scarce area when its rate of use of available water supply exceeds 80%. The fourth scenario reveals that an area with annual per capita water supply above 10 000 m³ is regarded as non-vulnerable or water surplus if its rate of use of available water supply is below 40% or swings between 40% and 60%. The same area transits to the status of a marginally vulnerable or water sufficient area when its rate of use of available water supply lies between 60% and 80% and transforms into a most vulnerable or water scarce area when its rate of use of available water supply surpasses 80%.

Also, in a worldwide survey on the potential of annual total water resources of countries where 50 African countries were included, Cameroon was credited with 285.50 cubic kilometers (km³) in 2011. Consequently, the country was classified as the 5th water abundant country in Africa after Democratic Republic of Congo (1283 km³), Republic of Congo (832 km³), Madagascar (337 km³), and Nigeria (286.20 km³) [CIA 2012].

3. Methodology

Cameroon is a lower-middle income country with a per capita gross national income (GNI) of US\$ 1210 based on the 2011 WB's classification of economies of the world [WB 2013d]. The country is located in Central Africa between latitudes 2° and 13° north of the equator and longitudes 8° and 16° east of the Greenwich meridian of the globe [“Office Central de Promotion Exterieur” (OCPE) 2007]. It has a total land mass of 475 650 square kilometers (km²) and shares boundary with Nigeria on the west, Central African Republic and Chad on the east, Equatorial Guinea, Gabon and Congo on the south, a small portion of Lake Chad on the north [National Institute of Statistics (NIS) 2006:2]. Cameroon is administered through 10 regions [“Cameroon Tribune” 2008: 3] with English and French as official languages binding over 250 spoken other languages [African Development Bank (AfDB) 2010: 13].

In 2010, Cameroon had a total population of 19 406 100 inhabitants and based on an annual average population growth rate of 2.6% [République du Cameroun/Republic of Cameroon (RC) 2010: 3], the total population of the country is projected to reach 38 812 200 inhabitants by 2037. The country's seasons of the year are split into dry and rainy. In the northern part of the country, the dry season runs from November to June and the rainy season covers the months of July to October, whereas in the southern area the dry season extends from January to March and the wet season lasts from April to December.

The data used to undertake the analysis were collected from institutions such as the Ministère de l'Énergie et de l'Eau (MINEE), NIS and Government in Cameroon, WB, CIA, and available literature on water resources management. Simple descriptive method of data analysis was used to capture the objectives of investigation with the help of analytical tools such as tables, percentages, and means. Personal observations were also helpful in the analysis of the various aspects of the inquiry.

4. Results and discussion

This section presents and discusses the results of the investigation. It is split into 3 subsections as follows.

4.1. Potential of water resources in Cameroon

Cameroon has 5 drainage basins including the Atlantic, Congo, Sanaga basins in the south, and Benue (Niger) and Chad basins in the north from which many rivers flow. The main rivers include the Ngoko (120 km), Dibamba (150 km), Mungo (150 km), Wouri (250 km), Ntem (400 km), Nyong (800 km), Sanaga (918 km), Benue (1400 km but 350 km in Cameroon) [Neba 1999; Molua & Lambi 2006], and Logone (390 km) [*The Encyclopaedia Britannica* 2010]. The country is also endowed with lakes among which are Lake Baleng in Bafoussam, Lake Ejagham in Mamfe, Lake Ossa in Edéa, Lake Bamenjim in Ndop, Lake Mefou in Yaoundé, and Lake Tizong in Ngaoundéré [Neba 1999; Molua & Lambi 2006]. Other important lakes in the country are Lake Chad in Makary, Lake Maga in Maga, Lake Lagdo in Lagdo, Lake Mbakaou in Tibati, Lake Wum in Aghem, Lake Nyos in Isu/Fundong, and Lake Borombi in Kumba. According to NIS [2006], the country receives an average amount of 1600 millimeters (mm) rainfall per annum and FAO [2013] explains that 60% of its total land mass is covered by forests.

The water supply of the country is drawn from 2 sources – namely surface and underground and it is mainly exploited to cover the needs for agriculture, households, energy, industries, transportation, recreation, and environment. Table 1 gives an overall assessment of the volume of water resources for Cameroon. It is observed that the annual aggregate volume of water resources for the country stands at 342.66 km³. Out of this volume, surface water accounts for 83.66% (286.68 km³) and underground water represents 16.33% (55.98 km³). Surface water accounts for a greater share of the total volume of water resources in Cameroon because a larger portion of Cameroon's land mass consists of compact lateritic soils that do not easily absorb water, thus facilitating the runoff and flow of rainfall waters into streams and rivers or their stagnation in lakes or reservoirs.

Table 1. Overall volume of water resources for Cameroon

Item	Surface waterresources (km ³)	Underground water resources (km ³)	Aggregate water resources (km ³)
Total	286.68 (83.66)	55.98 (16.33)	342.66 (100)

Note: Values in brackets are percentages.

Source: Oumar [2012].

The main users of water resources in Cameroon include the agricultural, domestic, hydropower, and industrial sectors of the economy. The annual aggregate water demand for the 4 sectors is estimated at 16.71 km³ and presented in Table 2. Out of the aggregate demand, the hydropower sector uses 91.02% (15.21 km³), followed by the agricultural (farming with 0.94 km³ and livestock breeding with 0.30 km³) sector with 7.42% (1.24 km³), the domestic sector with 1.49% (0.25 km³), and the industrial sector with a 0.05% (0.01 km³) share in the total demand. Further examination of Table 2 reveals that the hydropower sector is the main user of water in Cameroon, which can be explained by the fact that industries need more energy for their production plants and households too use more energy for their electrical appliances since the implementation by the government of the rural electrification project which presupposes the effective and efficient supply of electricity to users in all corners across the country.

Table 2. Annual aggregate water demand in Cameroon

Sector	Demand (km ³)	Percentage (%)
Agriculture	1.24	7.42
Households	0.25	1.49
Hydropower	15.21	91.02
Industry	0.01	0.05
Total	16.71	100

Source: Oumar [2012].

A contrast of the supply and demand for water resources in Cameroon is done in Table 3. The estimated aggregate water supply for Cameroon stands at 342.66 km³ per year. Out of this volume, only 4.88% (16.71 km³) was used to fulfill the water needs for agriculture, households, energy, and industry across the country. This leaves the country with a surplus volume of 95.12% (325.96 km³) of the available annual total water resources. The agricultural sector used only 0.36 % of the annual aggregate water supply of the country as opposed to 4.44% for the hydropower sector, while the industrial and domestic sector exploited less than 0.10% each of the annual total water supply of the country.

Table 3. Annual aggregate water supply and demand gap in Cameroon

Sector	Individual demand (km ³)	Supply (km ³)	Total demand (km ³)	Gap = Supply – demand (km ³)
Agriculture	1.24 (0.36)	342.66 (100)	16.71 (4.88)	325.96 (95.12)
Households	0.25 (0.07)			
Hydropower	15.21 (4.44)			
Industry	0.01 (0.003)			
Total	16.71 (4.88)			

Note: Values in brackets are percentages.

Source: Based on Oumar [2012].

In 2000, the annual total renewable water resources for Cameroon were estimated at 285.50 km³ with a per capita water supply of 19.19 m³ [FAO 2003: 78]. Compared with the world's annual volume of water resources of 42 700 km³ [Shiklomanov 1998: 9] whose per capita water supply is 7.82 m³ [Kulshreshtha 1993: 44] and Africa's annual total volume of water resources of 3991 km³ [Shiklomanov 1993] whose per capita water supply translates to 5.09 m³ [Kulshreshtha 1993: 47], the per capita water supply for Cameroon is approximately 2.5 times higher than the per capita water supply for the world and 4 times higher than that of Africa.

Comparing FAO [2003: 78] estimate of 2000 and 2011 CIA [2012] assessment of 285.50 km³ annual total renewable water resources for Cameroon, the estimate of 342.66 km³ annual total renewable water resources for the country by Oumar [2012] is by 57.16 km³ (342.66 – 285.50 = 57.16) per annum higher than the first two assessments, showing that within 12 years (2000-2012) the annual total renewable water resources for Cameroon have augmented by 20.02% with a per capita water supply reaching 23.03 m³ (19.19 × 20.02 = 384.18 ÷ 100 = 3.84 + 19.19 = 23.03). Although the climate change factor was ignored in the joint water availability and rate of use criterion for assessing the water availability status and the extent of water vulnerability of an area, based on this assess-

ment criterion one can deduce that with an annual per capita water supply of more than 10 000 m³ and an average use rate of 4.88% which is 8 times ($4.88 \times 8 = 39.04$) below the 40% rate of use level of the available total water resources, Cameroon falls in the category of water surplus-least vulnerable country.

Also it was observed that in 2000, Cameroon withdrew only 0.99 km³ or 0.35% ($0.99 \div 285.50 = 0.00346 \times 100 = 0.35$) of her annual total renewable water resources of 285.50 km³ from the environment to satisfy the water needs of sectors of economic activity [World Sites Atlas (WSA) 2008]. On the basis of this, it was anticipated in 2007 that with a population growth rate of 2.83% per annum for Cameroon, the water resources of the country would only deplete in 210 years [OCPE 2007: 148]. Based on the estimate of 342.66 km³ annual total renewable water resources for the country [Oumar 2012] and as at 2012, these resources would only run down completely in 247 years. Therefore as at 2016, all other things being equal, the water resources of Cameroon would completely run down in 201 years based on the estimation of FAO [2003] and CIA [2012], but as per the estimate of Oumar [2012], these resources would only deplete in 243 years. The scenarios discussed in this section substantiate and justify the claim that Cameroon is a water abundant country. Table 4 summarizes the discussion.

Table 4. Water resources potential for Cameroon

Year	Water potentials (km ³)	Life span (years)	Per capita water supply (m ³)	Source
2016	NA	243*	NA	*Authors
	NA	201*	NA	*Authors
2012	342.66	247*	23.03*	Oumar [2012], *Authors
2011	285.50	NA	19.19	CIA [2012]
2007	NA	210	NA	OCPE [2007]
2000	285.50	NA	19.19	FAO[2003], WSA[2008]

Note: NA – not available.

4.2. Quality of water resources in Cameroon

The water substance consists of 1 molecule of hydrogen (H₂) and 1 atom of oxygen (O). Its quality for drinking purpose is determined by taking into account factors such as the intensity of ionic concentration, level of microbes in it, and power of hydrogen (pH). To establish whether or not water from the surface or underground sources in Cameroon is safe for drinking purposes, emphasis is placed on the World Health Organization (WHO) [2011] standard values of pH (6.5 for acidic water and 8.5 for basic water, giving an average of 7.50) for

drinking water only [Commission du bassin du Lac Tchad (CBLT) & Union Internationale pour la Conservation de la Nature (UICN) 2007] for the analysis of all determinants of water quality is beyond the scope of this paper.

The surface water in the Lake Chad basin is basic (alkaline) in nature with average pH value of 7.25 that approaches the average WHO standard value of 7.50, thus it is less risky and acceptable for drinking purposes, based on pH value only. As regards the basins of Sanaga, Congo, and Benue (Niger), the surface water is acidic in some areas of with pH value less than 7 and alkaline in others with pH value greater than 7. The average pH value of surface water for the Congo basin is 7.05. In the Benue and Sanaga basins it is 6.85 and 6.92, correspondingly. Judging on the 7.50 average pH value of WHO, the surface water from the Congo basin can be regarded as less harmful for drinking purposes, but in the Benue and Sanaga basins it necessitates advanced treatment before its use for drinking purposes. In the Atlantic basin, the surface water is acidic in nature with average pH value of 6.25 which falls below the 7.50 average pH value of WHO. As a result, the water from the basin can only be used for drinking purposes after subjecting it to advanced treatment. The discussion on the quality of surface water is captured in Table 5.

Table 5. Boundaries of power of hydrogen (pH) for surface water quality

Item	pH value	Quality	Average pH ^a	pH status	Decision rule
WHO ^b	6.5-8.5	Acidic, basic	7.50	Standard	Acceptable
Lake Chad basin	7.2-7.3	Basic	7.25	Close	Acceptable
Sanaga basin	6.35-7.5	Acidic, basic	6.92	Below	Not acceptable
Congo basin	6.6-7.5	Acidic, basic	7.05	Close	Acceptable
Benue basin	6.4-7.3	Acidic, basic	6.85	Below	Not acceptable
Atlantic basin	5.8-6.7	Acidic	6.25	Below	Not acceptable

^a The calculation is based on simple arithmetic mean computation procedure.

^b Commission du bassin du Lac Tchad (CBLT) and Union Internationale pour la Conservation de la Nature (UICN) [2007].

Sources: Sigha-Nkamdjou [1994]; Ndam-Ngoupayou [1997]; MINEE [2005].

The underground water in the Lake Chad basin is naturally alkaline (basic) with average pH value of 7.25 which is close to the average WHO standard pH value of 7.50. Consequently, it is less harmful and can be used for drinking, based on pH value only. In the intermediary zone (Congo and Sanaga basins) and the Benue basin the water is alkaline in some areas with average pH value less than 7 and basic in others with average pH value greater than 7. The average pH value of water for the intermediary zone is 7.05 and its corresponding value for the Benue basin stands at 6.85. Compared to the 7.50 average pH value of WHO, it can be inferred that the water of the intermediary zone is less risky and

does not require advanced treatment before its use for drinking purposes, but the water from Benue basin necessitates advanced treatment before using it for drinking purposes. In the Atlantic basin, the water is naturally acidic with average pH value of 6, which is less than the 7.50 average pH value of WHO. As a result, it is unsafe to use it for drinking without proper treatment. Table 6 summarizes the discussion on the quality of underground water.

Table 6. Boundaries of power of hydrogen (pH) for underground water quality

Item	pH value	Quality	Average pH ^a	pH status	Decision rule
WHO ^b	6.5-8.5	Acidic, basic	7.50	Standard	Acceptable
Lake Chad basin	7.2-7.3	Basic	7.25	Close	Acceptable
Congo and Sanaga basins: Intermediary zone	6.2-7.9	Acidic, basic	7.05	Close	Acceptable
Benue basin	6.4-7.3	Acidic, basic	6.85	Below	Not acceptable
Atlantic basin	5.8-6.2	Acidic	6.0	Below	Not acceptable

^a The calculation is based on simple arithmetic mean computation procedure.

^b CBLT and UICN [2007].

Source: MINEE [2005].

From the analysis of the quality of water resources in Cameroon, a recapitulation is done in Table 7 to show the extent to which quality water is available for use in the country. It is observed that based on pH analysis only, 40% of surface water and 60% of underground water in Cameroon meets the requirements for drinking purposes. This implies that on the average 50% ($40 + 60 \div 2 = 100 \div 2 = 50$) of the water in Cameroon can be used for drinking purpose when the simple method of water treatment – boiling the water to 100° C and cooling it down before use is applied. The remaining half of the water may necessitate sophisticated methods of water treatment before using it for drinking purpose. A greater percentage of underground water meets the requirements of drinking purposes compared to surface water because surface water is exposed to several human activities and as such its quality can be tempered with or polluted easily.

Table 7. Extent of availability of quality water in Cameroon, based on analysis of power of hydrogen (pH)

Item	Surface water	Underground water	Total
Acceptable	2 (40)	3 (60)	5 (50)
Non-acceptable	3 (60)	2 (40)	5 (50)
Total	5 (100)	5 (100)	10 (100)

Note: Values in brackets are percentages.

Source: Based on Tables 5 and 6.

4.3. Level of people's access to basic social services

Cameroon is a prototype of sub-Saharan African countries where MDGs have not been attained as at December 2015. Considering its failure to achieve these goals, the Cameroon government launched the Cameroon of greater ambitions plan in 2011 and the Cameroon of greater achievements scheme in 2012 to drive the country to a status of an emerging economy in 2035. These two initiatives intended to raise the hope of Cameroonians that in 2035 they will secure better living conditions for themselves. How realistic this new arrangement is, constitutes a query that requires an analysis of the living conditions of people in Cameroon over time because previous Cameroon government promises as regards people's welfare held no substance at the end. A discussion on the level of people's access to drinking water, improved sanitation services, and electricity supply in Cameroon for the period 1990-2035 is carried out to confirm or refute the stated claims.

Table 8 presents the fraction of the population with access to drinking water, improved sanitation services, and electricity supply for the period 1990-2035 in Cameroon. Although the proportion of people with access to drinking water fluctuates between 49% and 63%, the average over the period of review is about 59% only. Also the fraction of the population with access to improved sanitation services which varies between 39% and 75% gives an average access level of 57% only for the period of review. Furthermore, the proportion of people with access to electricity supply ranges between 41% and 59% with an average access rate of 50% only over the period of review. A critical look at the average rate of the population with access to the three basic social services of life reveals that at least 50% of the population in Cameroon will continue to lack access to drinking water, improved sanitation services, and electricity supply till 2035 thus describing a situation of poor standard of living for people as a result of misplacement of priorities by the instances in charge of the enhancement of people's welfare in the country.

Table 8. Fraction of population with access to drinking water, improved sanitation and electricity supply in Cameroon, 1990-2035

Coverage	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Drinking water	49 ^a	56 ^b	63 ^a	59 ^c	61 ^c	60 ^c	60 ^c	60 ^c	60 ^c	60 ^c
Improved sanitation	39 ^d	43 ^c	47 ^d	51 ^e	55 ^e	59 ^e	63 ^e	67 ^e	71 ^e	75 ^e
Electricity supply	41 ^f	43 ^f	45 ^f	47 ^f	49 ^g	51 ^f	53 ^f	55 ^f	57 ^f	59 ^f

^a United Nations (UN) [2010a].

^b Calculation is based on average from 1990 and 2000 estimates of UN [2010a].

^c Calculation is based on average of estimates from 2 preceding years approximated.

^d UN [2010b].

^e Calculation is based on assumed increase of 4 percentage points every 5 years drawing from 1990 and 2000 estimates of 8 percentage points difference of UN [2010b] divided by 2.

^f Calculation is based on assumed increase of 2 percentage points every 5 years drawing from 2002 and 2007 estimates of 46% and 48% of LAUREA [s.a.: 12] on WB [2013c] estimate of 49% for 2010.

^g WB [2013c].

5. Conclusions

This section is organized into two subsections. Subsection 5.1 covers the contribution and implications of the inquiry, while subsection 5.2 identifies the limitations of the paper and future research areas on the subject matter of the paper.

5.1. Contribution and implications

Going by all available yardsticks of measuring the potential of water resources and water vulnerability status of Cameroon for it to qualify as a water abundant area, the country fits in very well in terms of both surface and underground water resources. The country is endowed with 5 drainages basins into which flow many rivers and stagnate several lakes or water reservoirs.

An assessment of the aggregate volume of water resources for Cameroon stands at 342.66 km³ per year, out of which only 4.88% (16.71 km³) is used to cover the water needs for agriculture (1.24 km³ or 7.42% of annual aggregate water demand for the 4 sectors), households (0.25 km³ or 1.49% of annual aggregate water demand for the 4 sectors), energy (15.21 km³ or 91.02% of annual aggregate water demand for the 4 sectors), and industry (0.01 km³ or 0.05% of annual aggregate water demand for the 4 sectors) across the country. The agricultural sector used only 0.36 % of the annual aggregate water supply of the country as opposed to 4.44% for the hydropower sector, while the industrial and domestic sector exploited less than 0.10% each of the annual total water supply of the country. Surface water accounts for 83.66% (286.68 km³) and underground water represents 16.33% (55.98 km³) of the annual aggregate volume of water supply of the country, and as at 2016, all other things being equal, these resources would only deplete in 243 years to come.

Based on WHO's 7.50 average pH value for assessing water quality, the analysis of the quality of water resources in Cameroon shows that on the average 50% of the annual total volume of water resources for the country can be used for drinking purpose when the water is boiled to 100° C and cooled down before using it. The remaining half of the volume of water may require sophisticated methods of water treatment before using it for drinking purpose.

In spite of the water resources potential in Cameroon, the standard of living conditions of people in the country is far below expectations for the population lacks adequate access to drinking water, improved sanitation services, and electricity supply that heavily depend on the availability of water resources. It is established that on the average only 59% of the population may have access to drinking water, only 57% of the population may afford improved sanitation services, and only 50% of the population may access electricity supply in the coun-

try over the period 1990-2035. A careful glance at the average rate of people's access to these three basic social services of life explains that at least 50% of the population in the country will continue to live without adequate access to drinking water, improved sanitation services, and electricity supply till 2035.

The facts presented here imply that Cameroon is endowed with surplus volume of water resources (325.96 km³ or 95.12% of annual total water resources) that marginally benefits the population owing to the mismanagement of resources and misplacement of priorities as obtained in most sub-Saharan African countries. Despite the observed situation, it is possible to substantially increase the rate of people's access to drinking water and improved sanitation services if a widespread mobilization and education campaign of the population about the simple water treatment technique is organized to involve the main users of water in the country. The share of the volume of water that may require heavy methods of water treatment and investments before using it for domestic activities can be handled by the instances in charge of people's welfare in the country.

As a result, it is necessary to take the following into consideration in order to improve people's welfare in the country. One, the government of Cameroon should encourage the population to run community basic social services projects and subsidize the activities of such ventures in kind through technical assistance or in cash. Two, the government of Cameroon should demystify the responsibility of providing basic social services by inviting volunteers into the creation of these services and offering the investors the opportunity of having the infrastructures put in place named after them as a sign of recognition.

5.2. Limitations and future research

The major limitations that call for further investigation on the subject matter of this paper include the following. There was the need to collect rich primary data on the various sectors using water in the country to determine the extent to which the resource contributes to their well-being. An estimate of how much usable water is produced and used in Cameroon could have also been determined from these data. The use of limited primary data in the present investigation offers no room toward establishing the extent of water resources allocation to the various users of water in the country. With rich data, the Chi-square test could have been run to compare the supply and demand for water at specific costs in the country. With individual data on the supply and demand for water of many users, a simultaneous equation regression analysis could have been run on the determinants of supply and demand for water in the country.

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