A Probe into the Rate of Access to Primary Socio-Economic Amenities in Cameroon for the Period 1990 to 2035

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Abstract

This paper analyses the potential access in Cameroon to primary socio-economic amenities, such as safe water, sanitation and electricity, and the extent to which the provision of these amenities in the context of the 2015 millennium development goals and Cameroon's Vision 2035 policy document for an emerging economy may reduce the suffering of people. A trend analysis was conducted, comparing the expected rates of access to the actual rates, using descriptive and inferential statistics on secondary data derived from the data banks of official sources. It was found that the demand for safe water, sanitation and electricity is largely unsatisfied, and that target rates of access to these socio-economic amenities are unlikely to be achieved by the 2015 deadline of the millennium development goals or by the 2035 deadline of Cameroon's Vision 2035 policy document for an emerging economy, despite the availability of a copious volume of water that is crucial to improving access to these amenities. This paper further shows that average rates of access to safe water, sanitation and electricity differ at first view, but the real difference is only evident between rates of access to water and sanitation on the one hand, and to water and electricity on the other hand, after conducting pairwise post-hoc tests. As this trend of events was found to continue, further investment in the provisioning of safe water, sanitation and electricity services, to achieve an average aggregate rate of access of at least 70% for the three primary socio-economic amenities in Cameroon, is recommended in this paper, in addition to the judicious execution of the vast capital projects initiated by government.

Keywords: *Household, water, sanitation, electricity, demand, Cameroon*

1. Introduction and Objectives

Water, sanitation and electricity are among the main socio-economic amenities needed to promote the social welfare of people. Owing to their importance, world leaders of 189 countries agreed, in 2000 at the United Nations Millennium Summit (UNMS), to set the year 2015 as a target for the attainment of eight specific millennium development goals (MDGs) for the world. One of these goals was the halving of the proportion of people without access to safe water, adequate sanitation world (European Commission [EC], 2013) and electricity coverage in the world. In line with these goals, the Government of Cameroon (GC) has committed itself to transforming the country into an emerging economy by the year 2035 (Republic of Cameroon [RC], 2009). Whether or not the country has sufficient resources to provide necessary socio-economic amenities such as safe water, adequate sanitation and electricity coverage is one question that needs attention. Another question is whether or not these targets can be achieved by the stipulated deadlines. A careful examination of living conditions in Cameroon from the perspective of an adequate supply of safe water, sanitation and electricity leaves much to be desired. The poor provisioning of these primary socio-economic amenities is a recurrent scenario confronting people in the country.

The flow of drinking water from the taps is very irregular, queues at water supply taps whenever water is available are long, and at worst people engage in travelling distances within a city or from city to city to fetch drinking water to avoid long waiting times. In desperate situations, people use water from rivers to perform domestic activities. In addition, an indifferent attitude of users to the public good is common, resulting in water taps being left open overnight so that, whenever drinking water is released by the supplying authority, water is wasted for long hours in addition to the widespread water leakages that are unattended for weeks by the water authority in various cities across the country. With reference to improved sanitation services, the habit of undermining elementary rules of hygiene is still engraved in the minds of the majority of the population. The habit of urinating and defecating anywhere in car parks, for example, is widespread since public and commercial toilets are absent, while the tendency to throw away rubbish and create dumping disposal grounds anywhere is common, despite the efforts of the sanitation services company of Cameroon (*Hygiène et Salubrité du Cameroun*: HYSACAM) to establish designated places for the dumping of waste.

The distribution of electricity by Applied Energy Services-*Societé Nationale d'Electrcité* (AES-SONEL), the electricity supply company, to the populace is another issue of concern in the country. Users of electricity are not guaranteed a constant supply, and can be without the service for as long as a week, for example. Sometimes, the supply of electricity is interrupted without prior notice. Users often leave their appliances switched on to enable them to notice the restoration of electricity when radios and lights come back on. And whenever electricity is restored, a spontaneous echo of "*Yeeeee"* is heard from people marking their relief that the blackout has ended.

Another serious problem for users of electricity in Cameroon is the extortion of monies from tenants by some unscrupulous landlords who legally receive electricity from AES-SONEL, but make a business out of it by charging their tenants a rate higher than the official rate of 79 FCFA (*Franc de la Communauté Financière de l'Afrique*) charged by AES-SONEL per unit of electricity consumed. In some cases, the extortion of monies comes in the form of requests by the landlord to the tenant to pay for extra units of electricity consumed per month, failing which may lead to the disconnection of the tenant from the landlord's electricity supply, depriving the tenant of electricity until the required payment is made. Subscribers to AES-SONEL are also confronted with incorrect electricity bills and as a result end up paying factitious electricity bills to avoid being charged for the late payment of bills or disconnected from the electricity supply network after the non-payment of the bills. Further, the reconnection of a subscriber to the electricity supply network, after the disconnection of the user from the grid by AES-SONEL for any reason, may subject the user to the payment of fines and reconnection charges.

These circumstances occur in a country well-endowed with natural resources that can be exploited to enhance the social well-being of the population, giving rise to the fundamental question as to whether or not the available resources lead to adequate access to drinking water, sanitation and electricity for people in the country. Perhaps the people of Cameroon's lack of awareness of the availability of these resources prevents them from lobbying for the improved provision of primary socio-economic amenities such as safe water, sanitation cover and regular electricity supply. Arguments raised in this paper may trigger initiatives by Cameroonians to demand better living conditions.

The following questions arise: (1) Does Cameroon have the water resources potential to provide adequate access to safe water, sanitation and electricity for its population? (2) Are the international and domestic targets for access to safe water, sanitation and electricity, respectively, as set by the 2015 MDGs agenda and Cameroon's *Vision 2035* policy document achievable by the stipulated deadlines or not? (3) Is there any difference in the rate of people's access to the three types of socio-economic amenities offered in the country given the potential of the natural resources at hand?

To answer these questions, this paper provides evidence of the amount of water available, the demand for water and the quality of water in Cameroon, it presents a trend analysis conducted to check the extent to which the country has achieved access to primary socio-economic amenities with respect to expected targets, and it compares the average access rates to these socio-economic amenities. Therefore, this paper is an attempt to inform the people of the country on how much is available to them and how it is actually offered to them with regard to the primary socio-economic amenities. Hence, the main objective of the paper is to investigate the extent of people's access to safe water, sanitation, and electricity in Cameroon for the period 1990-2035. Specifically, the intention is to:

- Examine the water supply potential and sectoral water demands in Cameroon;
- Appraise the extent of people's access to the main socio-economic amenities in Cameroon;
- Determine differences in access rates to the main socio-economic amenities in Cameroon; and
- Offer recommendations on how to improve the living conditions of people in the country.

The rest of the paper is organized as follows. Section 2 discusses the methodology, followed by the results and a discussion in section 3, while section 4 concludes the paper and makes recommendations aimed at the improvement of people's social welfare in the country.

2. Methodology

The methodology of the paper is broken into two sub-sections. Sub-section 2.1 provides a brief description of the study area, while sub-section 2.2 deals with the data and methods used in addressing the specific objectives of the inquiry.

2.1 Description of study area

Cameroon is a lower-middle income country with a gross per capita national income (GPCNI) of US$1210 based on the 2011 World Bank's classification of economies of the world (World Bank, 2013a). The country is located in Central Africa between latitudes 2^o and 13^o north of the equator and longitudes 8^o and 16^o east of the Greenwich Meridian of the globe (*Office Central de Promotion Exterieur* [OCPE], 2007). It has a total land mass of 475650 Km^2 and shares a boundary with Nigeria on the west, Central African Republic and Chad on the east, Equatorial Guinea, Gabon and Congo on the south, and 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 in addition to the over 250 local spoken languages (African Development Bank [AfDB], 2010:13) in a country of 19.4 million people in 2010. Based on the average annual population growth rate of 2.6%, projections estimate the population of the country to be 38.81 million people by 2037 (RC, n.d:3).

In Cameroon the 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 is from 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 country receives an average amount of 1600 mm rainfall per annum (NIS, 2006) with 60% of its total land mass covered by forest formations (Food and Agriculture Organization [FAO], 2013) out of which 41.70% was tropical dense forest and Savannah forest in 2011 (World Bank, 2013b).

Cameroon counts five drainage basins, including the Atlantic, Congo, and Sanaga basins in the south, and the Benue and Chad basins in the north containing many lakes and from which many rivers flow. According to Molua and Lambi (2006) and Neba (1999), the main rivers for Cameroon are the Sanaga (918 Km), Nyong (800 Km), Ntem (400 Km), Wouri (250 Km), Dibamba (150 Km), Mungo (150 Km), Ngoko (120 Km), Benue (1400 Km with 350 Km in Cameroon). The *Encylopaedia Britannica* (2010) completes the list with Logone (390 Km). Among the lakes, Baleng (Bafoussam), Ejagham (Mamfe), Ossa (Edéa), Bamenjim (Ndop), Mefou (Yaoundé), Tizong (Ngaoundéré) are cited by Molua and Lambi (2006) and Neba (1999), while others such as Mbakaou (Tibati), Chad (Makary), Borombi (Kumba), Maga (Maga), Nyos (Isu/Fundong), Wum (Aghem), and Lagdo (Lagdo) are not to be ignored because of their relevance to the surrounding communities in the country.

2.2 Data and methods of analysis

Data for the analysis were collected from the data banks of the *Ministère de l' Energie et de l'Eau* (MINEE) which is also known as the Ministry of Energy and Water Resources (MEWR), NIS and GC, World Bank, Central Intelligence Agency (CIA), and available literature on water resource management. To achieve the objectives of the inquiry, data related to each specific objective are drawn from different secondary sources and updated accordingly through simple arithmetic calculation of past rates or forecasting future rates of access by people to a particular primary socio-economic service for the years under investigation based on thresholds selected from the data banks of the institutions mentioned earlier. The analysis of water resources potential was done in three steps. First, water resource indicators from the literature were used to determine whether or not Cameroon is water surplus. Second, the extent of efforts and investment required to put available water to use was decided by assessing the amount of quality water available in Cameroon. Third, the sectoral water demand for the country was analyzed in relation to the total amount of water resources available. The trend analysis for access to safe water, sanitation and electricity was done by estimating and comparing expected targets of the 2015 MDGs and Cameroon's *Vision 2035* goal of an emerging economy, with actual achievements. The magnitude of the gap between levels of actual access to primary socio-economic facilities in the various years compared to that of the year 2015, the deadline for the achievement of the MDGs, and levels of access in the year 2035, the deadline for the accomplishment of the Cameroon *Vision 2035* goals, were accordingly computed to highlight when these targets are achieved.

The paper uses both descriptive and inferential methods of data analysis to capture the objectives of the investigation. The descriptive method employs percentages and tables, while the inferential approach utilizes the parametric test of one-way (one-factor) analysis of variance (ANOVA) on data corresponding to 30 different observations over the period 1990-2035 using the Excel software package. Overall, three groups of primary socio-economic amenities (safe water, sanitation, electricity) were considered in order to understand whether or not there is any difference in the rate of people's access to these services in the country by testing the statistical difference in the mean values of the different groups. Besides, the Excel and QI Macros Statistical process control (SPC) for Excel were used to generate descriptive statistics, and check data normality of the groups using the numerical, graphical and significance test methods. Also, after conducting the ANOVA test, some follow-up calculations such as Fisher's least significance difference (LSD) computation and Tukey's honestly significant difference (HSD) test were performed to determine where the difference in the means of the groups lies, accordingly. Finally, personal observations were used to complement the analysis with salient features on aspects of the studied phenomenon that are not available in the literature.

3. Results and Discussion

This section deals with results and discussion. It focuses on the amount of water available in Cameroon, the extent of quality water available in the country, sectoral demand for water against total water supply for the country, and the extent of people's access to safe water, adequate sanitation and proper electricity coverage. Also, the ANOVA test was run to establish whether or not there was any significant difference in people's rate of access to the primary socio-economic amenities of safe water, sanitation and electricity in the country.

3.1 Amount of water available in Cameroon

Cameroon is a relatively water abundant country because of the many rivers and lakes it is blessed with. Yet to confirm or refute this statement, there is the need to subject the volume of water resources of the country to some mathematical rigour as suggested by experts in the field of water resource management. Falkenmark et al.(1989), Abrams (2000-2001), Roudi-Fahimi et al. (2002), and the World Bank (2007) suggested the threshold of 1700 m^3 of annual volume of water per person as the universal minimum amount needed to effectively undertake all economic ventures in a country. In view of this, the annual volume of water per person for a country determines when the country can be classified as water surplus, water sufficient, water stressed or water scarce. Thus, using the approach of available volume of water per person, Brouwer and Falkenmark (1989) argue that any area with an annual volume of water per person falling below 1 thousand m^3 is a water scare area, while a region with an annual volume of water per person ranging between 1 thousand m^3 and 1700 m^3 is a water stressed area. Besides, an area where the annual amount of water per person corresponds with 1700 m^3 is a water sufficient area, while a place with an annual amount of water per person 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 in that area. Kulshreshtha (1993) proposes the combined water availability and use-level ratio criterion with four distinct scenarios to determine the extent of water vulnerability of an area, and explains with the first scenario that when the annual volume of water per person is less than 1 thousand m^3 and the water-use ratio of the available supply is less than 40%, the area qualifies as marginally vulnerable or water sufficient, but when the water-use ratio lies between 40% and 60% with the same annual amount of water per person, then the area is regarded as more vulnerable or water stressed. Conversely, when the water-use ratio is between 60% and exactly or above 80%, with an annual amount of water per person less than 1 thousand m^3, the area is classified as most vulnerable or water scarce. Outcomes similar to the first scenario where the annual amount of water per person is below 1 thousand m^3 are obtained with the second scenario when the annual volume of water per person ranges from 1001 m^3 to 2000 m^3.The third scenario concludes that when the annual amount of water supply per person varies between 2001 m^3 and 10 thousand m^3 and the water-use ratio is below 40%, the area is categorized as non-vulnerable or water surplus, but when the water-use ratio falls between 40% and 60%, the area becomes marginally vulnerable or water sufficient. Furthermore, when the water-use ratio fluctuates between 60% and 80%, the area is rated as more vulnerable or water stressed and it changes to the status of a most vulnerable or water-scarce area when its water-use ratio exceeds 80%. The fourth scenario reveals that an area with an annual volume of water per person above 10 thousand m^3 is regarded as non-vulnerable or water surplus when its water-use ratio is below 40% or swings between 40% and 60%. The same area changes its status to marginally vulnerable or to a water sufficient area when its water-use ratio lies between 60% and 80% and transforms into a most vulnerable or water-scare area when its water-use ratio jumps to more than 80%.

In 2011, in a worldwide survey of the potential of annual total water resources of countries in which 50 African countries were included, the CIA (2012) credited Cameroon with 285.50 Km^3 of water and ranked it the fifth country with copious amounts of water in Africa after the Democratic Republic of Congo (1283 Km^3), Republic of Congo (832 Km^3), Madagascar (337 Km^3), and Nigeria (286.20 Km^3). A recent estimate of 342.66 Km^3 annual total water resources for Cameroon by Oumar (2012) reclassifies the country to the third position among African countries after the two Congo countries. Similarly in 2011, an assessment by the World Bank (2013c) of access to safe water and adequate sanitation services with reference to the agenda of the MDGs between five African leading economies in their respective economic regions revealed that Cameroon is lagging behind Egypt by 20% and trailing South Africa by 12% in the access to safe water. Also, Egypt is ahead of Cameroon by 15% and South Africa is ahead of Cameroon by 21% in terms of access to adequate sanitation services (World Bank, 2013d). With 48.7% of people having access to electricity in 2009, Cameroon occupies the 55th position in the world in a cohort of 87 countries surveyed and ranks number 10 after Libya (99.8%), Egypt (99.6%), Tunisia (99.5%), Mauritius (99.4%), Algeria (99.3%), Morocco (97%), South Africa (75%), Ghana (60.5%), and Nigeria (50.6%), among the 33 African countries examined; even though it takes the fifth place among the 25 sub-Saharan African countries reviewed (World Bank, 2013e).

Cameroon draws its water resources from both underground and surface sources. The water drawn from these sources is mainly exploited to satisfy the needs of agriculture, households, hydroelectricity, industries, transportation, recreation and environment in the country. In the year 2000, about 0.99 Km^3 or 0.35% (0.99 ÷ 285.5 = 0.00346 * 100 = 0.35) of the country's total renewable water resources was withdrawn to gratify the water needs of various sectors of economic activity (World Sites Atlas, 2008). With a population growth rate of 2.83% per annum for the country, it was anticipated in 2007 that Cameroon's water resources would only deplete completely in 210 years' time (OCPE, 2007:148) or in the year 2211 from 2013. Table 1 gives an assessment of Cameroon's water resources. It shows that the volume of total water resources for the country is 342.66 Km^3 out of which underground water accounts for 16.33% (55.98 Km^3) and surface water for 83.66% (286.68 Km^3).

Table 1: Total volume of water resources for Cameroon

Feature	Underground water (Km^3)	Surface water (Km^3)	Aggregate water (Km^3)
Total	55.98 (16.33)	286.68 (83.66)	342.66 (100)

Source: Adapted from Oumar (2012) Values in brackets are percentages of total.

3.2 Amount of quality of water resources

Water is a substance made of 2 atoms of hydrogen (H_2) and 1 atom of oxygen (O). The quality of water depends on several parameters including radiological, microbial, chemical, and acceptability aspects (World Health Organization [WHO], 2011). However, only the power of hydrogen (pH) as one of the chemical parameters is considered in this paper to explain whether or not underground or surface water in Cameroon is safe for drinking, based on the WHO's standard thresholds of pH for safe water. Emphasis is placed on pH only because WHO (2011:226-227) considers it the most important operational water quality parameter that requires control at all stages of water treatment to guarantee acceptable water clarity and decontamination.

Quality of underground water: In the Atlantic Basin, the underground water is acidic with the power of hydrogen (pH) generally less than 7. The pH values of underground water within the basin fall outside the approved boundaries of the WHO. Based on this, the underground water of the basin is not suitable for drinking without proper treatment. In some parts of the middle zone basin (covering the Congo and Sanaga drainage basins) and the Benue Basin, the underground water is acidic with a pH of less than 7, and in others it is basic or alkaline with a pH greater than 7. However, the pH average of underground water for the middle zone is 7.05, while that of the Benue is 6.85. Compared to the 7.5 average of the WHO, it can be deduced that the underground water of the middle zone is less harmful and requires no extra treatment before using it for domestic purposes, whilst the underground water within the Benue Basin requires treatment before it is used for domestic activities. In the case of the Lake Chad Basin, the underground water is generally alkaline with an average pH (7.25) close to the international standard. As a result, the underground water within the basin is considered less polluted and it can be used for drinking. Table 2 gives a summary of the discussion of the quality of underground water based on an analysis of pH only.

Table 2: Boundaries of power of hydrogen (pH) for quality of underground water

Details	pH value	Quality	pH average#	pH status	pH difference x	Decision rule+
Atlantic Basin	5.8 – 6.2	Acidic	6.0	Below standard	1.5	Not suitable
Middle zone basin	6.2 – 7.9	Acidic, basic	7.05	Close to standard	0.45	Suitable
Benue Basin	6.4 – 7.3	Acidic, basic	6.85	Below standard	0.65	Not suitable
Lake Chad Basin	7.2 – 7.3	Basic	7.25	Close to standard	0.25	Suitable
WHO (w)	6.5 – 8.5	Acidic, basic	7.50	Standard	0	Suitable

(w): WHO (2011:227); +: If the difference between standard threshold pH of WHO (w) and estimated average pH is greater or equal to 0.5, then consider the quality of water not suitable for drinking; X: Authors

Sources: MINEE (2005); #: Oumar (2012)

Quality of surface water: The surface water of the Atlantic Basin is acidic with boundaries of the pH values being less than 7, and falling outside the approved limits of the WHO. This makes the water of the basin unacceptable for drinking without proper treatment. In some areas of the Congo, Sanaga and Benue basins the surface water is acidic with a pH of less than 7, and in others it is basic with a pH greater than 7. The pH average of surface water for the Congo Basin is 7.05, whilst in the Sanaga and Benue basins it is 6.92 and 6.85, correspondingly. Compared to the 7.5 average of the WHO, the surface water of the Congo Basin is regarded as less contaminated and it can be used for domestic activities without additional treatment, while the surface water for the Sanaga and Benue basins requires proper treatment before using it for domestic activities. Further, in the Lake Chad Basin the surface water is usually basic with an average pH of 7.25, very close to the average standard of the WHO. As a result, the surface water in the basin can be considered less harmful and used for drinking. The discussion of the quality of surface water based on the analysis of pH only is captured in Table 3.

Table 3: Boundaries of power of hydrogen (pH) for quality of surface water

Details	pH value	Quality	pH average #	pH status	pH difference x	Decision rule+
Atlantic Basin	5.8 – 6.7	Acidic	6.25	Below standard	1.25	Not suitable
Congo Basin	6.6 – 7.5	Acidic, basic	7.05	Close to standard	0.45	Suitable
Sanaga Basin	6.35 – 7.5	Acidic, basic	6.92	Below standard	0.58	Not suitable
Benue Basin	6.4 – 7.3	Acidic, basic	6.85	Below standard	0.65	Not suitable
Lake Chad Basin	7.2 – 7.3	Basic	7.25	Close to standard	0.25	Suitable
WHO(w)	6.5 – 8.5	Acidic, basic	7.50	Standard	0	Suitable

(w): WHO (2011:227); #: Oumar (2012); +: If the difference between standard threshold pH of WHO (w) and estimated average pH is greater or equal to 0.5, then consider the quality not suitable for drinking; X: Authors

Sources: MINEE (2005); Ndam-Ngoupayou (1997); Sigha-Nkamdjou (1994)

The analysis of the extent of the quality of water resources in Cameroon presented in Table 4 shows that based on the pH values, 50% (29.99 Km^3) of underground water and 50% (143.34 Km^3) of surface water in Cameroon is suitable for residential use without the need to perform extraordinary water treatment techniques before it can be consumed. Taking the average of the two rates, one can argue that 50% (171.33 Km^3) of the 342.66 Km^3 total water resources of Cameroon, as underlined by Oumar (2012), is less harmful for consumption. Considering that only 4.876% (16.7 Km^3) of the total water resources is used to satisfy the overall water demand of the various sectors of economic activity (agriculture, households, hydroelectricity and industries) in the country, all of which do not, however, require quality water in their activities except for households and food processing industries, it is evident that at least 45.124% (154.63 Km^3) of the quality water can still be used to provide safe water and proper sanitation services to users in the country.

Table 4: Extent of quality water based on analysis of power of hydrogen (pH)

Details	Underground water	Surface water	Percentage (%)
Acceptable	3 (60)	2 (40)	50
Unacceptable	2 (40)	3 (60)	50
Total of basins	5 (100)	5 (100)	100

Source: Based on Table 2 and Table 3

Based on the analysis of the magnitude of quality water resources in Cameroon, it is possible to have the water demand for all sectors of economic activity satisfied without much difficulty so as to improve the social welfare of the people in the country. The water demand for households and processing industries can be handled by the 50% volume of quality water available in the country, while the other half of the country's total amount of water resources, which requires additional treatment before use, can be utilized to accommodate the needs of hydroelectricity generation to satisfy the electricity demand for the entire country in future.

3.3 Sectoral water demand

In Cameroon the demand for water comes from agriculture, households, hydroelectricity and industries. The annual total water demand for the four sectors is estimated at 16.7 Km^3 and presented in Table 5. Out of the aggregate demand, the hydroelectricity sector uses 91.01% (15.21 Km^3), followed by the agricultural (farming with 0.93556 $Km^3$and livestock breeding with 0.300463 Km^3) sector at 7.39% (1.24 Km^3), the domestic sector at 1.5% (0.251 Km^3), and the industrial sector with a 0.09% (0.01512 Km^3) share in the total demand. Further examination of Table 2 reveals that the hydroelectricity sector is the main user of water in Cameroon, which stems from the fact that industries need more electricity for their production plants and that households use more electricity for electrical appliances, as a result of the commitment from the government to implement the rural electrification project across all corners of the country.

Table 5: Annual aggregate demand for water in Cameroon

Sector	Demand (Km^3)	Percentage (%)
Agriculture	1.236023	7.39
Households	0.251	1.50
Hydroelectricity	15.21	91.01
Industry	0.015119	0.09
Total	16.710472	100

Source: Oumar (2012)

A water supply and demand comparison for Cameroon is presented in Table 6. The estimated total water supply of the country is 342.66 Km^3 per year. Out of this volume, only 4.876% (16.7 Km^3) is used to fulfil the water needs of agriculture, households, hydroelectricity and industry sectors across the country, leaving an unused surplus volume of 95.12% (325.96 Km^3) of the total water resources. The agricultural sector used only 0.36 % (1.236 Km^3) of the aggregate supply as opposed to 4.44% (15.21 Km^3) for the hydroelectricity sector, while the industrial and domestic sectors exploited less than 0.10% (0.0151 Km^3 and 0.251 Km^3) each of the total water supplies in the country.

Table 6: Annual total water supply and demand gap by sector in Cameroon

Sector	Demand (Km^3)	Supply (Km^3)	Gap in Km^3 (Supply – demand)	Percentage use of supply	Gap as percentage of supply
Agriculture	1.236023	-	341.423977*	0.361*	99.639*
Households	0.251	-	342.409*	0.073*	99.926*
Hydroelectricity	15.21	-	327.45*	4.448*	95.561*
Industry	0.015119	-	342.644881*	0.004*	99.995*
Total	16.710472	342.66	325.96	4.876	95.126

Source: Adapted from Oumar (2012) *: Authors

3.4 Extent of people's access to primary socio-economic amenities

Worldwide, the annual volume of water resources comes to 42700 Km^3 (Shiklomanov, 1998:9) for a volume of water supply per person of 7.824 m^3 per year (Kulshreshtha, 1993:44). At the level of continents, Africa's annual volume of water resources aggregates to 3991 Km^3 (Shiklomanov, 1993) for a volume of water supply per person of 5.087 m^3 per annum (Kulshreshtha, 1993:47). Based on the FAO 2000 estimate of 285.5 Km^3 of annual total renewable water resources for Cameroon, the annual volume of water supply per person for the country translates to 19.192 m^3 (FAO, 2003:78). These statistics show that the volume of water supply per person for Cameroon is approximately 2.5 times higher than the water supply per person for the world and 4 times higher than that of Africa. Also, the annual total water resources of 342.66 Km^3 in 2010 reported by Oumar (2012), is higher by 57.16 Km^3 (342.66 – 285.50 = 57.16) per annum than the 285.5 Km^3 reported by the FAO in 2000 (FAO, 2003:78). This is an indication that between 2000 and 2010, the annual total water resources of Cameroon appreciated by 20.02%. Although the climate change factor was ignored in the joint water availability and use-level ratio criterion for assessing the water availability status and the extent of water vulnerability of an area, Oumar and Tewari (2013) argue that with an annual volume of water supply per person above 10 thousand m^3 and an average use rate of 0.5% (< 40%) of available water resources for the period 1990-2020, Cameroon qualifies as a water surplus-least vulnerable country, hence the justification that Cameroon is a water-abundant country.

In the last decades of the 20th century, the UN through its various organs proposed the provision of primary socio-economic facilities for all people by the year 2000. This proposal entailed the provision of safe water, sanitation, food, health, shelter (WHO/United Nations Children's Fund [UNICEF], 1978:3-5,17, 34 and 47), education (Inter-Agency Commission [IAC], 1990:164; World Education Forum[WEF], 2000:1), better transport linkages (EC, 2013:26), and respect at work (International Labor Organization [ILO], 1998:1-2) for all in the 21st century, which would have made 2000 a year of jubilation at the removal of human discomfort and the restoration of human dignity on Earth. Unfortunately by the year 2000, this great and ambitious plan for humanity produced more disappointment than happiness in the eyes of most people. Yet, the failure of this gigantic project educated world leaders on the need to target feasible deadlines for achievable goals. Subsequently a more realistic project was formulated within the agenda of the MDGs to attempt a reduction by 50% of the sufferings confronting humanity, including access to primary socio-economic facilities, such as safe water, education, electricity, clean environment and health, by the year 2015. No doubt some successes have been registered here and there relating to the target areas of the MDGs agenda across the world, but still a lot needs to be done, particularly in Africa south of the Sahara, as there is little impetus towards the actualization of these goals by the target date of 2015.

Cameroon is a typical example of a sub-Saharan country where the MDGs seem very hard to achieve by the deadline of 2015. In anticipation of the perceived impossibility of the country to meet these goals by the target date, the GC launched a series of programs, such as Cameroon's "Greater Ambitions" program in 2011 and the "Greater Achievements" program in 2012, intended to propel the country to the status of an emerging economy by 2035 under the canopy of Cameroon's *Vision 2035.* Such programmes were intended to nurture and entertain hope that by the year 2035 almost all, if not all the ingredients required to fuel better living conditions for all must have been developed for the country. How realistic this new arrangement is, constitutes a query that requires investigation because all previous promises from the government held no substance in the end. The proportion of people with access to safe water, improved sanitation services and electricity coverage in Cameroon for the period 1990-2035 is presented in Table 7 and discussed accordingly.

Access to safe water: In 1990, 49% of the population consumed safe water as against 56% for 1995, 63% for 2000, 70% for 2005 and 77% for 2010. It is anticipated that 84% of the population may have access to safe water by 2015, 91% by 2020 and 98% by 2025. Likewise, the proportion of people's access to safe water may reach 105% in 2030 and 112% in 2035. A careful examination of the data in Table 7 reveals a rising pattern in people's access to safe water for the period under appraisal. This improvement is associated with the increased involvement and commitment of non-profit organizations in the provisioning of safe water in the country. The MDGs agenda sets out to halve the poverty rate by 2015, taking the 1990 level of poverty as the reference point. Reducing poverty is synonymous with increasing people's access to primary survival needs such as dignified jobs, food, shelter, health care, education, safe water, adequate sanitation, electricity, transportation and the like. It is therefore logical to predict an inverse relationship between the level of poverty and the rate of people's access to the main survival needs, so that to accomplish a 50% reduction in the level of poverty in society, at least double the 1990 rates of access to the main survival needs are required. This hypothesis is utilized to understand the achievements of the GC with regard to the provisioning of safe water, adequate sanitation and electricity amenities for people, building on the 1990 levels of access as against the projected 2015 rates of access of the MDGs and the 2035 goals of the Cameroon *Vision 2035* policies for an emerging economy. Consequently, based on the 49% rate of access for people to safe water in the country in 1990, one expects 98% (49 *2 = 98) of the population to have access to safe water by 2015. However, column 7 of Table 7 shows a rate of access of 84% for 2015, describing a shortfall of 14 percentage points against the anticipated projection. The projected rate of 98% is only reached 10 years later, that is, in 2025 after which 100% coverage as planned according to the Cameroon *Vision 2035* policy document is attained with a 5 points increase in 2030 and a 12 points increase in 2035. A plausible explanation for this situation is found in the mismanagement of various capital investment projects put in place long ago by the government.

Access to sanitation: In 1990, 39% of the population had adequate sanitation, as against 43% for 1995, 47% for 2000, 51% for 2005 and 55% for 2010. It is anticipated that 59% of the population may have access to proper sanitation by 2015, 63% by 2020 and 67% by 2025. Similarly, the proportion of people with access to sanitation may extend to 71% in 2030 and 75% in 2035. A careful examination of the data in Table 7 reveals a rising pattern in people's access to enhanced sanitation services for the period under analysis. This is associated with the launching of an awareness campaign on hygiene and sanitation after the initiation of the MDGs in the country. Likewise, based on the 39% rate of access of people to adequate sanitation in 1990, it is assumed that 78% (39 *2 = 78) of the population may have access to sanitation by 2015. Yet, column 7 of Table 7 shows that only a 59% rate of access is to be achieved by 2015, thus indicating a deficit of 19 points compared to the predicted target. Although the shortage between the expected rate of

78% and the actual rate narrowed down to 11 points in 2025 and 3 points in 2035, it is evident that access to adequate sanitation remains a big challenge for the country. This is mainly associated with the slow response to efforts to change peoples' behaviour, especially in remote areas of the country where the greater portion of poor levels of sanitation exists.

Access to electricity: In 1990, 41% of the population accessed electricity compared to 43% for 1995, 45% for 2000, 47% for 2005 and 49% for 2010. It is expected that 51% of the population may access electricity by 2015, 53% by 2020 and 55% by 2025. The proportion of people with access to electricity may expand to 57% in 2030 and 59% in 2035. A careful inspection of the data in Table 7 reveals a rising pattern in people's access to electricity for the period under consideration. This is partly explained by the increased use of alternative sources of lighting such as generators and solar panels by people in the country due to the intermittent supply of electricity from AES-SONEL. Similarly, considering the 1990 magnitude of a 41% rate of access to electricity in the country and anticipating a level of access of 82% (41*2 = 82) by 2015, the actual performance of 51% for 2015 (column 7 of Table 7) indicates that the country is expected to register a debit of 31 points in 2015, 27 points in 2025, and 21 points in 2035. Here too, there is a clear indication that despite the decrease in the deficit rate of people's access to electricity over the years, lack of access to electricity may continue to be problematic for many people in the country even by the deadline of the Cameroon *Vision 2035* policy document, even though the option of solar energy is being explored, albeit inadequately, in some parts of the country. One major reason for this poor performance is the inefficiency and ineffectiveness of AES-SONEL on site, the bureaucratic procedure, exorbitant costs associated with connection requests, delays in responding to users' complaints and the selective distribution of the service to favourite users.

Table 7: Proportion of population with access to safe water, sanitation and electricity in Cameroon, 1990-2035

Years / Coverage	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035
Safe water	49*	56a	63*	70a	77a	84a	91a	98a	105a	112a
Sanitation	39**	43b	47**	51b	55b	59b	63b	67b	71b	75b
Electricity	41c	43c	45c	47c	49***	51c	53c	55c	57c	59c

a: Authors – Calculation is based on assumed increase of 7 percentage points every 5 years drawing from 1990 and 2000 estimates of 14 percentage points difference of UN (2010a) divided by 2.; b: Authors – 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.; c: Authors – 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 (n.d:12) on the World Bank (2013e) estimate of 49% for 2010.

Sources: *United Nations [UN] (2010a), ** UN (2010b), *** World Bank (2013e)

3.5 Testing for statistical difference of means with one-way analysis of variance

Statistical literature reports that the running of the ANOVA parametric test fundamentally requires sample data normality. This implies that the data need to be normally or near normally distributed (Keller, 2009). The skewedness and kurtosis indices numerical approach of the Pearson and the Anderson-Darling (AD) significance test approach are used to check the normality of the data. The numerical approach is used for its popularity and ease of understanding even among non-experts in Economics. Conversely, the AD test is considered because it is a modification of the Kolmogorov-Smirnov (KS) test and it places more emphasis on the tails than is done with the KS test as explained in the literature (Stephens, 1974). The KS test is distribution free in the sense that the critical values do not depend on the specific distribution being tested, whereas the AD test makes use of the specific distribution in calculating critical values. Above all, the AD test allows for the performing of a more sensitive test and avoids the disadvantage of calculating critical values for each distribution (Stephens, 1974; iSixSigma.com, 2000-2014a). However, before conducting the tests, it is necessary to generate the descriptive statistics of the samples under consideration.

Descriptive statistics: The descriptive statistics of interest are the mean, median, variance, skewedness and kurtosis of data of the 3 groups. As a result, the mean and median rate of access by people to safe water fluctuated between 50% and 80.5%; whilst the variance ranged between 36.666 and 449.166 for the 3 samples. Further, the skewedness and the kurtosis are 0 and -1.2, respectively. These statistics are presented in Table 8 followed by a discussion of the data normality test of the samples.

Table 8: Descriptive statistics results for the three groups

Amenity	Score	Mean	Median	Variance	Skewedness	Kurtosis
Safe water	10	80.5	80.5	449.166	0	-1.2
Sanitation	10	57	57	146.666	0	-1.2
Electricity	10	50	50	36.666	0	-1.2

Source: Estimation

Data normality test: Focusing on the numerical approach, the descriptive statistics show that the skewedness of 0 and kurtosis of -1.2 for the 3 groups provide evidence that the data are normally distributed since the numerical indices of skewedness and kurtosis for any normal distribution must lie between -2 and 2 standard deviation from the mean (McCluskey and Lalkhen, 2007:129). The AD test seeks to determine the closeness of a set of data to the normal distribution and generally makes a decision based on p-values. As a result, if the calculated P-value (P Stat) is greater or equal to the critical p-value (p crit: α) then reject the null hypothesis (H_0) that the data are not normal, otherwise accept H_0 (iSixSigma.com, 2000-2014a). Alternatively, reject H_0 that the data are not normal if the calculated A-squared (A Stat) is lesser than the critical A-squared (A crit), otherwise accept it (iSixSigma.com, 2000-2014b). Thus, given the requirements of the decision rule and the results obtained from the test as presented in Table 9, there is strong proof that the data for the 3 groups are normally distributed because their computed respective P-value of 0.957 is greater than the critical p-value of 0.05. Conversely, their computed A-squared value of 0.141 is lesser than their corresponding critical A-squared value of 0.787 at the considered 5% level of significance. This provides the opportunity to conduct the ANOVA test proper as done after Table 9.

Table 9: Results for data normality test of the three groups

Approach	Parameter	Safe water	Sanitation	Electricity	Decision rule	
Numerical	Skewedness	0	0	0	[-2, 2]	Data are normal
	Kurtosis	-1.2	-1.2	-1.2	[-2, 2]	
Significance test	Anderson-Darling (AD)	0.957 > 0.05	0.957 > 0.05	0.957 > 0.05	P Stat ≥ p crit, reject H_0	
		0.141< 0.787	0.957 > 0.05	0.957 > 0.05	A^2 Stat < A^2 crit, reject H_0	

Source: Estimation

The ANOVA test: The hypotheses for the 3 groups are specified below and tested at 5% level of significance. The decision rule for the test is to reject the null hypothesis (H_0) if the computed F value (F Stat) is *greater* than the critical F value (F crit) or the computed P-value is *less or equal* to the critical p-value (α).

Null hypothesis (H_0): There is no statistical difference in the average rate of people's access to primary socio-economic amenities with regard to safe water, sanitation, and electricity in Cameroon.

Alternate hypothesis (H_1): At least one average rate of people's access to primary socio-economic amenities is statistically different with regard to safe water, sanitation, and electricity in Cameroon.

The ANOVA results presented in Table 10 show that at 5% level of significance, the means of the access rate to safe water, sanitation and electricity are statistically different because the computed F value of 12.106 is greater than the critical F value of 3.354 at the corresponding degrees of freedom of 2 and 27. This is also obvious while looking at the p-values since the computed P-value of 0.0000176 is lesser than the critical p-value of α = 5% (0.05) at these degrees of freedom, hence the evidence to reject H_0.

Table 10: One-way ANOVA results for the three groups

Parameters	Safe water, sanitation, electricity
Number of scores (n)	30
Level of significance (critical p-value)	0.05
Computed P-value	0.0000176
Df 1	2
Df 2	27
F crit (F critical value)	3.354
MSB (variation between)	2552.5
MSE (variation within)	210.8333
F Stat (F computed value)	12.106
Decision rule	Reject H_0 (F Stat > F crit)
Conclusion	Means are different

Source: Estimation

Pairwise test for determining statistically differing means: The ANOVA test provided evidence for rejecting H_0 and concludes that the average rates of people's access to safe water, sanitation and electricity in Cameroon are different. Since only one mean difference among the means of the 3 groups is sufficient to reject H_0, the ANOVA test does not explicitly specify which of the means are different. To determine the differing means, pairwise tests can be performed on the various groups. The Fisher's least significance difference (LSD) computation, Scheffe's test, and Tukey's honestly significant difference or Tukey-Kramer (HSD) test are methods by which this can be achieved, but in this paper only the LSD computation and the HSD test options are utilized for the following reasons. First, the two options are chosen because the Scheffe's test is generally designed for samples of unequal sizes and in this present case all groups are of equal size. Second, prominence is given to the HSD test because the LSD computation has been criticized for its inability to adequately control for Type I error as opposed to the greater power and dependability of the HSD test to control for pairwise rate of error between groups over other tests in most cases (Newsom, 2006). The means M1, M2, and M3 are respective averages for safe water, sanitation, and electricity.

The pairwise results of the LSD computation and the HSD test for the 3 groups are shown in Table 11. The results explain that M1 is statistically different from M2 and M3 at 5% level of significance, because the computed values are all greater than the critical values in both the LSD computation and the HSD test, hence the rejection of the null hypothesis (H_0) that there is no statistical difference between the means of the groups. However, the results indicate that M2 and M3 are statistically the same at 5% level of significance because the computed values are lesser than the critical values in the LSD computation and the HSD test, thus the failure to reject H_0.

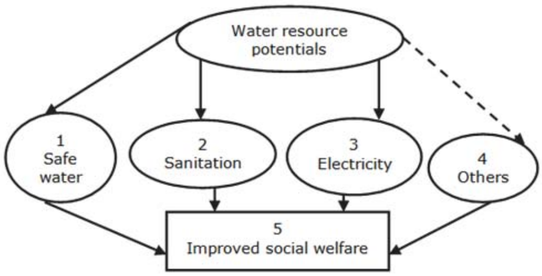
Table 11: Pairwise test results for determining statistically differing means between the groups

Mean (M)	Analytical tool			
	LSD computation		HSD test	
M1 and M2	Computed value	Critical value	Computed value	Critical value
Result	23.50	13.323	5.188	3.506
Decision rule	Computed > Critical		Computed > Critical	
	Reject Ho		Reject Ho	
Conclusion	M1 ≠ M2		M1 ≠ M2	
M1 and M3	Computed value	Critical value	Computed value	Critical value
Result	30.50	13.323	6.643	3.506
Decision rule	Computed > Critical		Computed > Critical	
	Reject Ho		Reject Ho	
Conclusion	M1 ≠ M3		M1 ≠ M3	
M2 and M3	Computed value	Critical value	Computed value	Critical value
Result	7	13.323	1.524	3.506
Decision rule	Computed < Critical		Computed < Critical	
	Accept Ho		Accept Ho	
Conclusion	M2 = M3		M2 = M3	

Source: Estimation

Given the importance of water as a resource in the provisioning of socio-economic amenities, such as safe water, adequate sanitation and electricity coverage that are directly dependent on it, and others that depend on it indirectly, a holistic approach to the provisioning of these amenities is imperative for the improvement of the social welfare of people in the country. A framework towards achieving this aim is suggested in Figure 1 to explain that the available amounts of water resources can be utilized to serve people's direct needs for survival, such as safe water, sanitation and electricity, as indicated by the continuous arrows that link the upper circle of water resource potentials to the improved social welfare box on the diagram by passing through those three immediate needs of people in the country. The dotted arrow linking the upper circle of water resources to the circle on the extreme right-hand side of the diagram explains that the other amenities (shelter, roads, schools) required for social welfare improvement of people are not dependent on water resource directly.

Figure 1: Framework for social welfare improvement through provision of main socio-economic amenities



4. Conclusion and Recommendations

This paper establishes that there is extensive potential for water resources in Cameroon, but the distribution of primary socio-economic amenities, such as safe water, sanitation and electricity, that are heavily dependent on water resource availability are poorly provisioned and below the expected 2015 target of the millennium development goals and the 2035 target of the Cameroon *Vision 2035* policy document. It also argues that half of the annual total water resources of the country are suitable for residential uses without the need to perform extraordinary water treatment techniques. Furthermore, it maintains that only about 5% of the country's total amount of water supply is exploited for the water needs of all sectors of economic activity operating in the country. Yet, despite the existence of these water surpluses, the living condition of people is below expectation and their social welfare degraded. The mean comparison results for the 3 primary socio-economic facilities examined show that at 5% level of significance the average access rates to safe water, sanitation and electricity are different. However, pairwise post hoc follow-up tests established that the difference in the means is statistically only significant between the access rate to water and sanitation on the one hand, and between water and electricity on the other hand. As regards sanitation and electricity, the mean difference was found to be statistically insignificant. Hence, the paper makes the following recommendations.

First, since it observed that people have started exploring the option of solar energy use, there is the need to facilitate the acquisition of this type of energy by creating a conducive environment for the suppliers of this service and making solar panels affordable to the poor. This may bring competition to the energy sector and break the monopoly of electricity supply held so far by the Applied Energy Services-*Societé Nationale d'Electrcité* (AES-SONEL) – the electricity supply company. Second, there is the need to disseminate simple techniques of water treatment and hygiene to the public across the country. Third, the numerous capital investment projects initiated for the sake of safe water, sanitation and electricity provision by the government on the eve of political campaigns need to be executed to their logical conclusion. Fourth, though the average rate of access to safe water over the period of review is at least 23.5 percentage points above the averages for sanitation and electricity, because drinking water is typically used for subsistence needs, it is imperative to substantially increase the average rates of access for the latter (sanitation and electricity) that do not require as much quality and control measures as does the former (safe water), so as to achieve an average aggregate rate of access of at least 70% for the three main socio-economic amenities combined. This increase may tremendously improve the social welfare of people in the country. Fifth, both the Cameroon Water Utilities Corporation-*Camerounaise des Eaux* (CAMWATER-CDE) – the water supply company and AES-SONEL – the electricity supply company - need to be nationalized and run within the tenets of good governance. Finally, further inquiries that incorporate additional and influential socio-economic facilities need to be carried out in order to measure fully the extent of social welfare in the country.

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