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RESEARCH ARTICLE

Water Scarcity and Local Management Strategies on the Kup-Njiseng Watershed and Environs of the Nkambe Plateau, North West Region, Cameroon

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Abstract

Water scarcity constrains livelihood sustenance and predisposes the population to frustration and conflicts, and generally deteriorates their quality of life. The growth in population, ineffective water management policies and damaging water sources are at the fore of water scarcity. Such predispositions have scaled up global concerns on sustainable managerial approaches for water availability and safety. This paper seeks to provide a synthesis of key themes and knowledge about the correlation between water scarcity and local management strategies drawing empirical evidence from the Kup-Njiseng Watershed and environs (KNW) in Binka village (BV) on the Nkambe Plateau (NP). Data were gleaned from existing literature, focus group discussions, interviews and questionnaires (80) to respondents in the field. Satellite images of over 40 years were used to analyze land cover/use and change to water catchments and anthropogenic activities around and within the watershed. Quantitative and qualitative techniques were adopted for the study while the SWOT analysis was incorporated in the analysis of the results. Response score of 62.5% revealed that poor management and maintenance of existing water networks is the main reason for water scarcity and conflict while scores of 25 and 12.5% indicate that increases in unsustainable anthropogenic activities and population around catchment areas are rife. Again, the proactive nature of the population towards a sustainable management scheme has resulted in partial water stability. It is recommended that an efficient local management board for effective sustainable water management be ensured for posterity.

Keywords: Catchment, Conflicts, Management Strategies, Water Scarcity.

1. Introduction

Water is a limited natural resource and fundamental for life and health (OHCHR, 2002). Many parts of the world face the problem of water scarcity, especially in the tropics, semi-arid regions and arid areas (Dalezios et al., 2018, Bensen, 2022). Approximately 1.2 billion people, or almost one-fifth of the world's population, live in areas of scarcity while another 1.6 billion people, or almost one-quarter of the world's population, face economic water shortage (where countries lack the necessary infrastructure to take water from rivers and aquifers) (FAO, 2007). About two-thirds of the world's population lives in areas that experience water scarcity for at least one month a year (Mekonnen and Hoekstra, 2016). The growth in population and unsustainable exploitation of water have resulted in dwindling quantity and quality of water as a third of the world's biggest groundwater systems are already in distress (Richey et al., 2015).

Water scarcity predisposes significant constraints on livelihood sustenance. About 42% of people in Sub-Saharan Africa (SSA) live without basic water supply (Joint Monitoring Program of WHO and UNICEF, 2017) and 2.1 billion people (UN-SDGs Baseline),

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lack water services reaching the new standards, including 159 million who still drink untreated water directly from surface water sources such as streams or lakes (WHO/UNICEF, 2015) at the global scale. Water scarcity is among the greatest challenges of the 21st Century as overpopulation, corruption, agriculture, pollution of water and improper management policies are the important reasons for water scarcity (Dalezios et al., 2018, Bensen, 2022) coupled with environmental exigencies (Klobucista and Robinson, 2023) and changes in farming habits of agricultural land (Stephane et al., 2020). Despite the scarcity of this precious utility, the population especially farmers insist on its use causing conflicts of interest and the tragedy of the common resources (Gholizadeh and Niknami, 2020). Water availability is one of the basic human needs in its adequate quantity and quality (UNICEF/WHO, 2017) and improving access to safe drinking water is important (Shannon et al., 2008) as inscribed in Goal 6.1 of the United Nations Sustainable Development Goals (2015). Goal 6 calls for improving water quality, as well as for protecting and restoring water-related ecosystems while Goal 6.1 seeks to ensure the availability of safe drinking water for all by the year 2030. To achieve safe drinking water for all, much has to be done and fast especially in developing countries by meeting the criteria for safe drinking water (WHO/UNICEF, 2018). The implementation of better policies and governance, more funding, improved infrastructure and improved data for better decision-making as well as the adoption of science, technology and innovation to increase the efficiency and effectiveness of existing water could be the panacea (UN Economic and Social Council, 2023).

The current world's population stands at 8.1 billion people (United Nations, Worldometer, 2023) which is growing at an annual rate of 0.88% with about 70 million people adding per year. According to the (United Nations World Water Development Report, 2023), 2 billion people in the world do not have access to clean and safe drinking water while between 1.7 to 2.4 billion people may face water scarcity especially in cities. The report furthers that competition for water will increase to about 80% within the next three decades for agriculture which consumes about 70% of fresh water globally. It is known that 70% of the earth's surface is covered with water and 3% of it is actually fresh water which lies frozen in the Antarctic and Greenland polar ice with just 1% of it being fit for human consumption (TWAS, 2002).

To improve the quality of life for the people of Africa, the AfDB through providing better access to safe drinking water has supported 43 million people with access to safe water since the year 2015 (AfDB, 2020). Though the issue of accessing safe drinking water is highly prioritized in the various national, continental and international policy documents, strategy papers and declarations, it is not clear if the provision of sustainable access to safe drinking water has been given the required financial support by the SSA policy makers and donors (Salami et al., 2011), thus, making access to safe drinking water a continuous problem to the people. The provision of safe drinking water has been prioritized in the AfDB's 'High 5s' Strategic vision and results that are transforming Africa intended to support African countries' achievement of the SDGs (AfDB, 2020). The AfDB's High 5s indicates that 42.7 million people need improved access to safe water. According to Joint Monitoring Program (http://www.wssinfo.org/en/welcome.html), Cameroon shows a progressive improvement in access to improved water from 50 in 1990, 57 in 1995, 64 in 2000, 71 in 2005 and 74 in 2010 percent of total population respectively. The AfDB's High 5s in 2015 stressed on transforming the continent transition to green growth by mainstreaming sustainable development initiatives through investments in sustainable water resource management which is also highlighted as a critical priority in Agenda 2063 for Africa (AfDB, 2023).

The Bamenda Highlands of Cameroon host numerous dilute and soda springs of unknown hydrological provenance which are a vital source of drinking water for the population (Wirmvem et al., 2020). Though, with the presence of these numerous springs, the inhabitants still go about their daily activities with inadequate piped water supply, thus, relying most on groundwater from open dug wells and springs (Abendong et al., 2019) and rainwater collection. This difficulty emanates from its geology with an important geomorphological system consisting of basement rocks made up of leucogranite of Precambrian age overlain with volcanic materials (Morin, 1988) which are composed of mafic and felsic lavas (Nzenti et al., 2010).

The numerous water catchments of Binka village are located within the Kup-Njiseng watershed and environs on the Nkambe Plateau which is an ecological hotspot with ecological diversity. This ecological hotspot acts as a carbon sink and secures water resources through numerous water catchments. Despite these riches,

water scarcity still remains a problem in recent times. Ineffective water management policies, increasing human and animal populations, in-disciplined lifestyle, biased attitudes and unsustainable human activities around the watershed have affected the quantity and quality of water, thus, making it a scarce commodity. Though water has become a scarce commodity in the study area in recent times, different quarters and households have varying degree of scarcity. There is a need to increase water-related infrastructure or exploit new water catchments as well as replace obsolete and broken infrastructural assets. Efficient and effective measures for the continuous supply of water depend on the organization of the relief, the stream network as well as the geology of the area (Chiaga, 2019). In effect, catchments are instrumental in the effective functioning of hydrological systems as they ensure ground water recharge and a steady supply of water for multiple uses (Kimengsi et al., 2018) and this effective functioning warrants the social, economic and institutional factors operating within and outside the catchment where planning, implementing, monitoring and evaluating a course of action over time (Zimmermann, 1996) is needed, perfect condition for Kup-Njiseng Watershed on the Nkambe Plateau. The consistent and repeated calls for water catchments sustainability by local stakeholders seem to have received limited expectations from the entire population of the study area, thus, shunning the opinion of Zimmermann (1996).

The extent of water scarcity in the Kup-Njiseng Watershed and environs is indeterminable until accurate data is collected, treated and analysed in a way to come out with casualties. It is therefore against this backdrop that this paper seeks to: (1) identify water potentials of the Kup-Njiseng Watershed and environs, (2) trace the spatial distribution of water resources in Kup-Njiseng and environs, (3) examine the drivers of water scarcity in Kup-Njiseng Watershed and environs and (4) find out the constraints and effects of water scarcity on the population in order to examine local stakeholders' role in sustainable water management in the study area.

2. Study Area and Methodology

2.1 Study Area

Kup-Njiseng Watershed and environs in Binka village is located on the Nkambe Plateau in Donga/Mantung Division of the Bamenda Highlands in the North West Region of Cameroon. It lies between longitude 10o44'-10o48'E and latitude 6o30'-6o34'N with an altitude between 1,500 m-2,200 m (Figure 1). The area carved out for study covers a total surface area of 7039.23ha and the area includes Bomba, Ngwemeng and Ngotang all in Upper Binka. The study area is found on a dissected undulating lava plateau with extensive flows of Andesitic basalt lava that were extruded from fissures with a north-east-south-west alignment that makes up the Bamenda Highlands (Hawkins and Brunt, 1965). The study area has rich water resources ranging from water trickles to main streams such as Mambah, Mateng, Koku, Kumangfu, Chiwouh, alongside many springs such as Mbuku, Larrye, Mfbuhmyee, Sirrnto as well as many catchments. The stream banks are used for second cycle vegetable cultivation but are highly marred by stray animals. The springs also serve as alternative water sources for households, especially during the dry season when the water table in the catchments falls below the threshold.

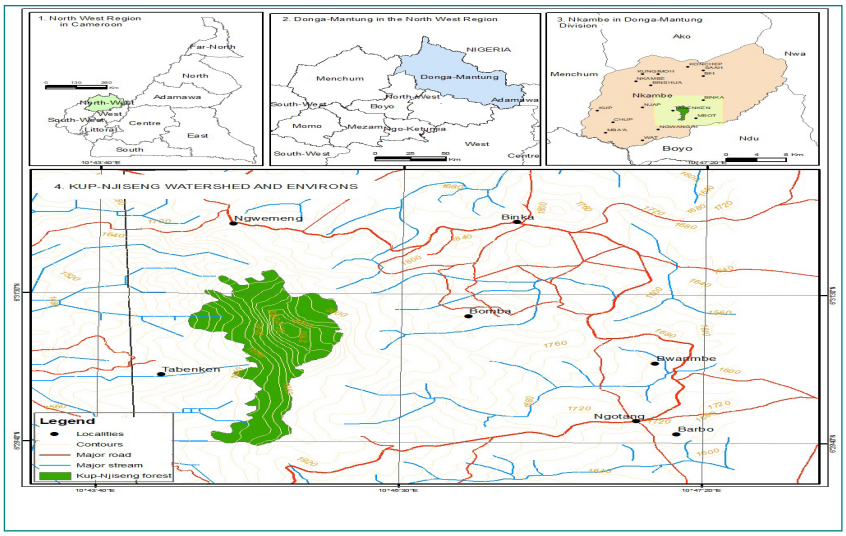

Figure 1. *Kup-Njiseng watershed and environs on the Nkambe Plateau*

2.2 Methodology

The study used both secondary and primary data sources. Information on ENVI land cover change in the Kup-Njiseng Watershed and environs over the last 40 years was obtained from the analysis of Landsat Images from 1993-2023. These images were obtained through an open-source platform (glovis, USGS) and the images were captured between December and January to appreciate the degree of water scarcity as false results would have been obtained if captured during the rainy periods when the water table must have recharged. ENVI, ArcGIS, excel and shape files were used for image and statistical analysis respectively. Both qualitative and quantitative methods were used in data analysis. Secondary data sourcing was obtained from literature related to the study from diverse sources while primary data sources were obtained from questionnaire administration to 80 respondents in 3 neighbourhoods. Interviews and focus group discussions were held with water catchment and water distribution managers, individuals with private taps, those using public taps, grazers, farmers and the traditional authorities of Binka village. The questionnaire was prepared to generate information on the nature of water availability and regularity of flow, availability of catchments, management strategies, and the potential of the watershed to sustain rural livelihood. This was to establish a relationship between water scarcity and the management strategies that could sustain water availability for rural livelihood. The Strength, Weaknesses, Opportunities and Threats (SWOT) analysis approach was used to gain an understanding of the strengths and opportunities of the watershed as well as to find out the weaknesses and threats in adopting and implementing strategies for a sustainable policy framework as it was considered the most valuable approach for this study. The questions of the questionnaire were based on open and closed-ended questions about the strengths and weaknesses, opportunities and threats on the sustainability of the catchments in the watershed and environs. Using the SWOT analysis, respondents' responses were collected to obtain a holistic understanding of the potential threats to the catchments in the watershed. It allowed the identification of the most effective strategy that maximizes strength and capabilities and minimizes weaknesses and threats as stipulated by (Saaty, 1987; Mbongsi et al., 2023). Based on the collected data, simple statistical tables and a table for SWOT were prepared and analyzed.

3. Results

3.1 Water Potentials of Kup-Njiseng Watershed and Environs

The Kup-Njiseng Watershed is a montane forest that has numerous rich catchments that supply potable water to a large population such as those of Bomba, Ngotang, Ngwimeng neighbourhoods all in upper Binka village and even beyond. The rich catchments are located in different places in the forest and slopes of the mountain (Kup-Njiseng). Out of the nine (9) catchments present, two (2) are harnessed and are in use in the village. The main storage tank at Mawhu supplies water to the many minor tanks around the village. Water is supplied to the many stand taps for consumption from the minor tanks through conveyor pipes. A variety of water potentials such as infrastructural, physical and human would have made it possible for water to be available though in insufficient suppies throughout the year (Table 1).

Table 1. *Water potentials of Kup-Njiseng and environs*

Catchment	Infrastructural assets	Physical potential	Human potential
Doga, Ndipmtarr,	Main storage tanks (Mawhu and Doga)	High relief produces the needed pressure to pump water	Large population for water exploitation and consumption
	Many minor storage tanks (In strategic points in the study area)	Forest provides moisture to the catchment areas	Available and ready labour force (skilled and unskilled)
	Numerous stand taps	A large watershed	Funds availability

The high relief enables water to flow with force while the forest provides moisture protection to the catchments. Cheap and ready labour is provided by the large population. The main storage tank is located at Mawhu while the one in Ngotang (Doga) has its unique water storage tank around the catchment area. The construction of small storage tanks and stand taps around the study area is an indication of abundance water and high demand from the population which is marred of recent with dry tanks and pipes especially during the dry season. These tanks help to release the high pressure that usually accompanies the water flow to avoid pipes breakage especially during the rainy season when the water table is highly recharged.

3.2 Spatial Distribution of Water Resources in Kup-Njiseng and Environs

The Kup-Njiseng is the main watershed of the Nkambe Plateau in Donga-Mantung Division. Kup-Njiseng and environs is endowed with a litany of catchments, rivers and streams spread all over the study area. This study area constitutes the main water basin of the area (Figure 2). These streams and rivers take their rise from the Kup-Njiseng watershed. The area has the highest elevation at 2200m and water supply is solely the responsibility of the Local Water Management Committee (LWMC). These water resources serve as common pool resources which are liable to pollution emanating from increasing population and their activities.

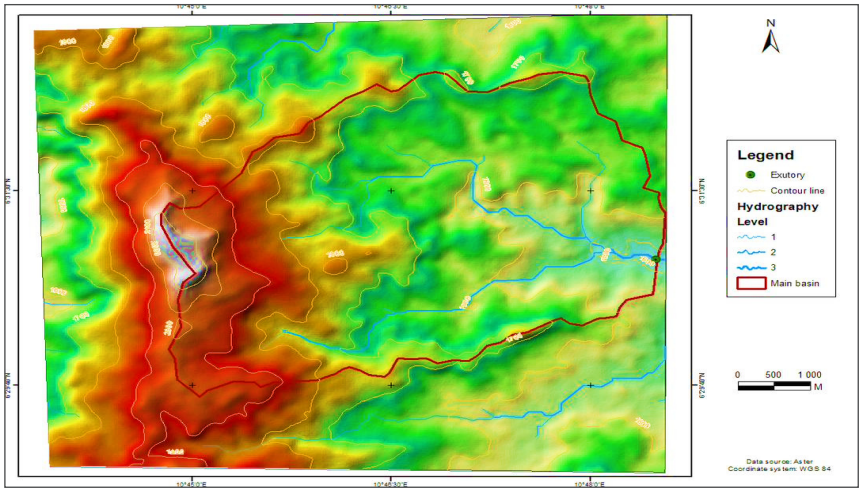

Figure 2. *Hydrological basin of Kup-Njiseng and environs-Binka village Source: Aster Image, 2022; WGS84 and fieldwork, 2023*

3.3 Drivers of Water Scarcity in Kup-Njiseng and Environs

Water scarcity in Kup-Njiseng and environs is typically man made than physical causes. It has diverse and multiple causes vis-à-vis poor management and maintenance of water infrastructure and assets, increased in population, unsustainable anthropogenic activities, irresponsible lifestyle (corruption) among others (Table 3).

Table 3. *Drivers of water scarcity in the Kup-Njiseng and Environs*

Drivers Neighborhoods	Poor management and maintenance	Unsustainable human activities at catchments	Increased population
Bomba	26	5	5
Ngwimeng	15	8	3
Ngotang	9	7	2
Total	50	20	10
%	62.5	25	12.5

Binka village being a rich water resource community has been hit by water scarcity not because of natural factors that are often the main drivers of scarcity, but because of human causes rooted in poor water governance. As gotten from field investigations, the main water scarcity driver emanates from poor water management and maintenance of water infrastructure and assets with a score of 62.5%. The main issues surrounding this shortcoming revolves around corruption and illicit water distribution where biased attitudes are highly recorded. Those in charge of water management distribute water to those who give them stipends especially during the dry season while the masses are left with no choice than to search for alternative water sources in springs and streams with doubtful quality. Another hindrance to safe water is unsustainable anthropogenic activities around the catchment areas with a score of 25% of the population who also testified that they cultivate crops and rear animals because of the richness in pasture, water and fertile soils, thus, encroaching into protected areas and destroying the friendly and protective vegetation. It was obsereved that the surroundings of the catchments and springs were mainly cultivated and fire used to clear the thick vegetation especially during the dry season (Plate 1).

Plate 1. *Catchment areas and surroundings endangered. Photo (1) is a catchment with a storage for distribution through the main pipe to the main storage tank covered by thick vegetation. Photo (2) is another catchment that have been seriously encroached by farmers and fire used in clearing the vegetation cover and photo (3) shows another storage tank in a catchment with cultivated land right surrounding the tank in the catchment.* ***Source:*** *The Voice of Binka and fieldwork, 2023*

This thick vegetation cover is characterised by layers of accumulated debris forming humus on the soil surface, thus, making the soil fertile. Respondents acknowledged the fact that increase in population has contributed to water scarcity with a 12.5% score. The increase in population has exerted tremendous pressure on the watershed in general and the catchment areas in particular, thus, causing degradation, leading to shortages of water in the catchments conveying water into the storage tanks and consequently, water scarcity and poor life quality (Figure 3).

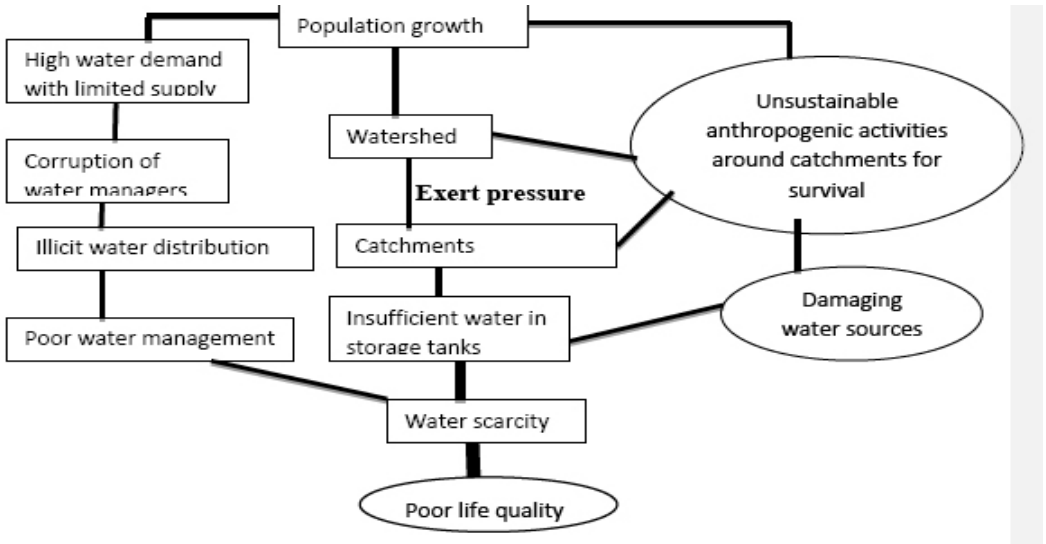

Figure 3. *Causes of water scarcity in Kup-Njiseng and environs-Binka village Source: Author's conception, 2023*

Increase in population has also led to an unprecedented high demand in water which has undoubtedly met limited supply due to the unsustainable activities in and around the ctachment areas. This phenomenon has pushed water managers into biased attitudes such as corrupt practices where water is illicitly distributed to those who are able to pay stipends while little attention is given to the masses. This attitude, however, has rendered water management activities poor and unreliable especially to those who really need the resource. The consequence of this act has caused the less priveleged and the poor to suffer from water scarcity most.

3.4 Land Cover and Use over Time in the Kup-Njiseng Watershed and Environs

Increase population instigates activities such as farming and grazing which in turn require space and water. Space here refers to the land cover related to the value attached to it by the population for sustenance. Land cover use has undergone serious mutations with consequential effects especially on water over the years (1993-2023) using remotely sensed data with quantifiable estimates in a total surface area of 7039.23ha. Statistics in 1993 indicate dominance in farmland with a surface area of 4133.81ha (58.73%) and luxuriant forest with 984.08ha (13.98%). Savannah land cover represents 1150.28ha (16.34%), grazing land occupies 503.97ha (7.16%) while secondary forest extended for 214.78ha (3.05%) but settlement land cover represent 47.11ha (0.67%) as against 5.2ha (0.07%) for land occupied with water (Table 4 and Figure 4).

Table 4. *Land cover/use distribution on Kup-Njiseng Watershed and environs in 1993*

Land cover/use type	Area covered in (ha)	Percentage (%)
Farmland	4133.81	58.73
Grazing	503.97	7.16
Luxuriant forest	984.08	13.98
Savannah	1150.28	16.34
Secondary forest	214.78	3.05
Settlement	47.11	0.67
Water	5.2	0.07
Total	7039.23	100.00

Source: *Landsat 05 Image (1993) LM05*

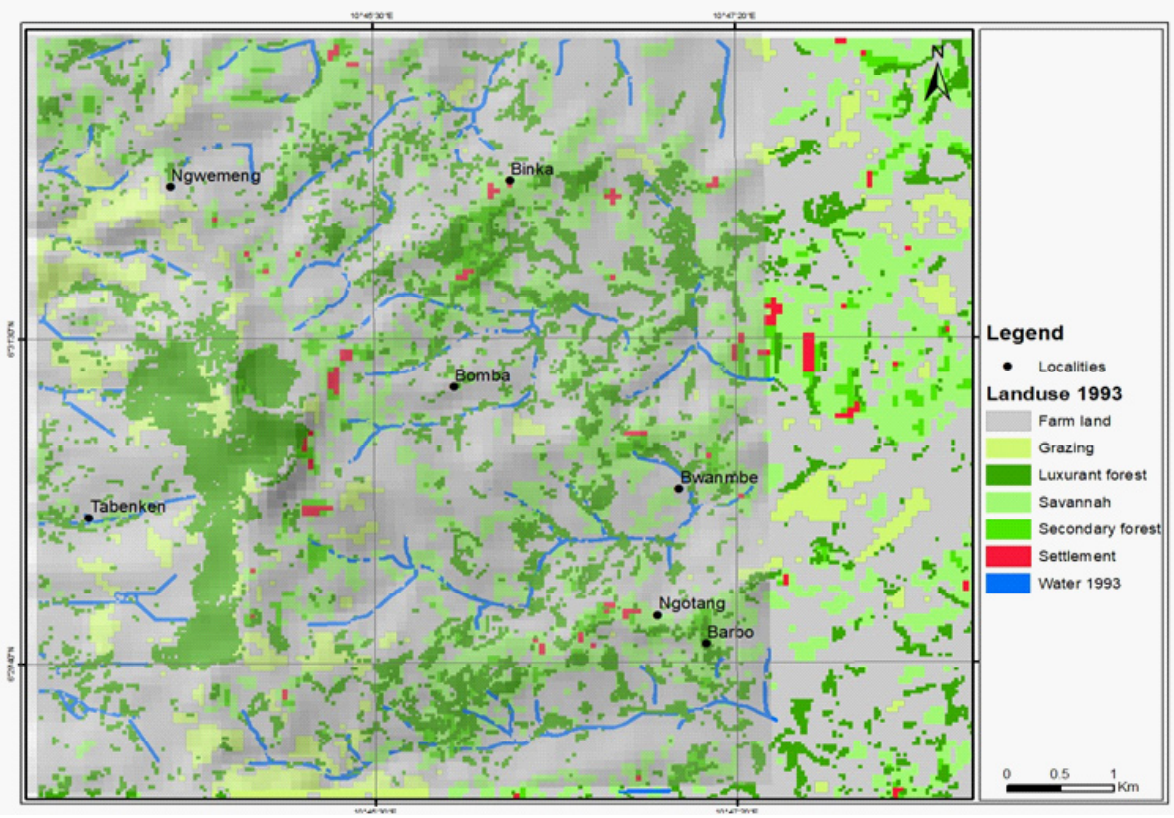

Figure 4. *Land cover change in Kup-Njiseng watershed and environs, 1993 Source: Landsat 5 image, 1993 LM05 and fieldwork,2023*

In 2003, evidence of increasing farmland 4712.68ha (66.94%), increasing settlement 52.72ha (0.67%), decrease in savannah 1015.52ha (14.43%) and decrease in secondary forest became glaring with reductions in water land cover 4.81ha (0.07%) (Table 5 and Figure 5). The decrease in savannah, grazing land and secondary forest gave way for farming, thus, increasing farmland to produce more food for the increasing population. The increase in farmland and settlement has a detrimental effect on water land cover as increase in population warrants more space for crop cultivation and water for domestic use. Crops especially during the dry season are cultivated along river beds and wetlands which exacerbate water shortages in and around the catchments, thus, causing water scarcity. The removal of the vegetation for farming activities also exposes the water catchments to harsh environmental conditions such as increase in the rate of evaporation which causes a fast release of water vapour into the atmosphere. This in turn affects the quantity and quality of water which consequentially, engenders water scarcity.

Table 5. *Land cover/use distribution on Kup-Njiseng Watershed and environs in 2003*

Land use	Area covered in (ha)	Percentage (%)
Farmland	4712.68	66.94
Grazing	127.72	1.81
Luxuriant forest	1079.16	15.33
Savannah	1015.52	14.43
Secondary forest	47.1	0.67
Settlement	52.72	0.75
Water	4.81	0.07
Total	7039.71	100.00

Source: *Landsat 06 Image (1993) LM06*

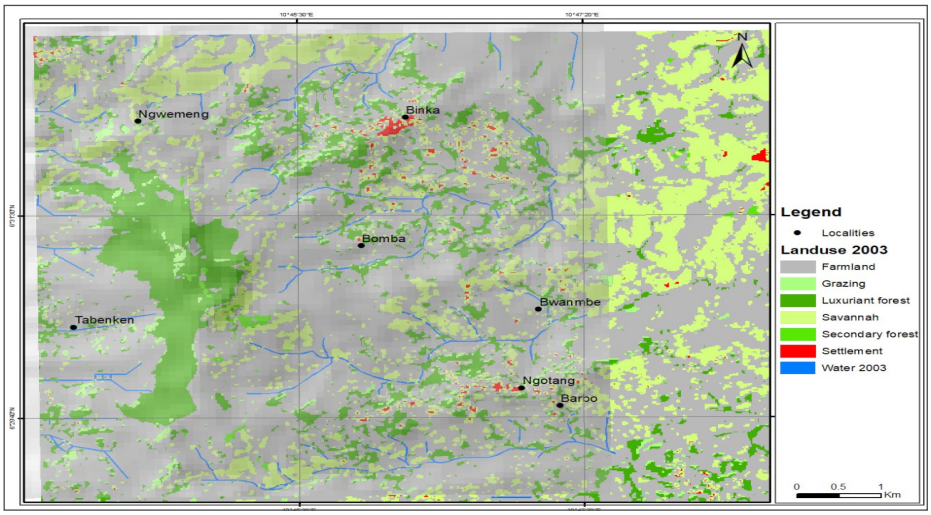

Figure 5. *Land cover change in Kup-Njiseng watershed and environs, 2003 Source: Landsat 6 image, 2003 LM06 and fieldwork,2023*

In 2013, there is a drop in farmland 4805.83ha (61.19%), luxuriant forest 905.07ha (13.95), savannah 1021.01ha (13.85%) and secondary forest 40.68ha (0.55%) to the benefit of grazing land 411.44ha (5.58%) and settlement 61.27ha (0.83%) with detrimental effects on water land cover/use 3.99ha (0.05%) (Table 6).

Table 6. *Land cover/use distribution on Kup-Njiseng watershed and environs in 2013*

Land use	Area covered in (ha)	Percentage (%)
Farmland	4805.83	65.19
Grazing	201.44	5.58
Luxuriant forest	905.07	13.95
Savannah	1021.01	13.85
Secondary forest	40.65	0.55
Settlement	61.27	0.83
Water	3.99	0.05
Total	7039.26	100.00

Source: *Landsat 07 Image (1993) LM07*

Following a traditional injunction placed on anthropogenic activities in and around the catchments in 2010, illegal grazing activities intensified and colonized the abandoned farmlands. Settlement also expanded towards water bodies (springs, streams and rivers) for market gardening crops cultivation and domestic uses. It was gathered in the field that grazers who were mostly from the Mambela Highlands in Nigeria and neighbouring villages around the study area brought in their cattle to settle and graze aroundthe slopes of Kup-Njiseng. It is reported that they disrespected the injunction order and went ahead with illegal grazing of their animals. These anthropogenic activities, however, have consequential effects on the watershed and its catchments, thus, instigating water scarcity. The construction of houses is water demanding as earth blocks used for construction are molded near water sources or water is conveyed to the molding site for proximity. As settlement increases alongside anthropogenic activities, water sources disappear leading to water scarcity (Figure 6).

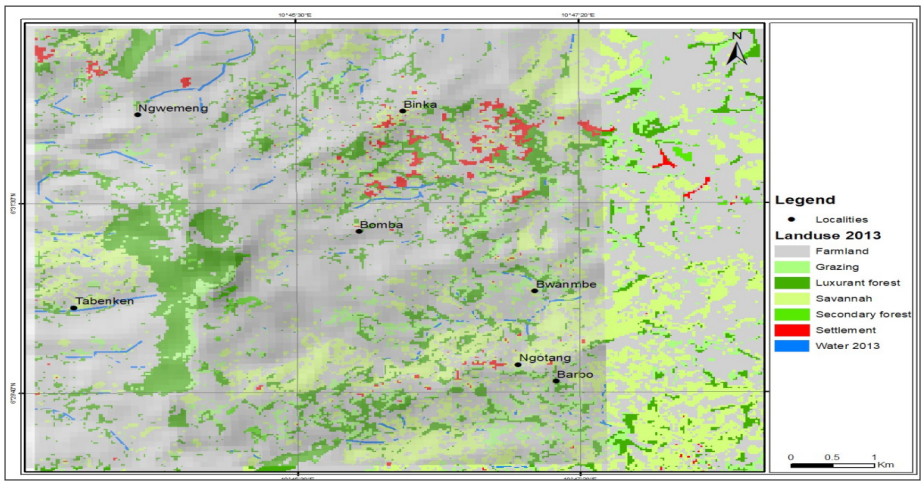

Figure 6. *Land cover change in Kup-Njiseng watershed and environs, 2013 Source: Landsat 7 image, 2013 LM07 and fieldwork,2023*

In 2023, there is remarkable drop in farmland to 4176.99ha (59.34%), grazing land to 318.6ha (4.53%), secondary forest to 20.93ha (0.30%) while luxuriant forest increased to 1326.51ha (18.84%) and settlement to 204.75ha (2.91%) (Table 7). Farmland and grazing land lose to luxuriant forest following traditional stringent laws laid in 2016 placing a ban on all anthropogenic activities around and in the watershed area and its catchments. The population on their part has continued to exploit the secondary forest for their activities due to the inadequate and fertile lands to support their activities. Though farmland and grazing activities gave way for luxuriant forest, a longer time is needed for the water table to be recharged and stabilize for sufficiency, a phenomenon common with natural systems. The continuous increase in settlement with an upward decrease in water 2.76ha (0.04%) is a clear indication of water scarcity in the study area over the years (Table 7 and Figure 7). This water scarcity is highly linked to over exploitation and low water table recharge in the catchment areas as well as unsustainable anthropogenic activities around the catchment areas.

Table 7. *Land cover/use in 2023*

Land use	Area (ha)	Percentage (%)
Farmland	4176.99	59.34
Grazing	318.6	4.53
Luxuriant forest	1326.51	18.84
Savannah	988.64	14.04
Secondary forest	20.93	0.30
Settlement	204.75	2.91
Water	2.76	0.04
Total	7039.18	100.00

Source: *Landsat 08 Image (2023) LM08*

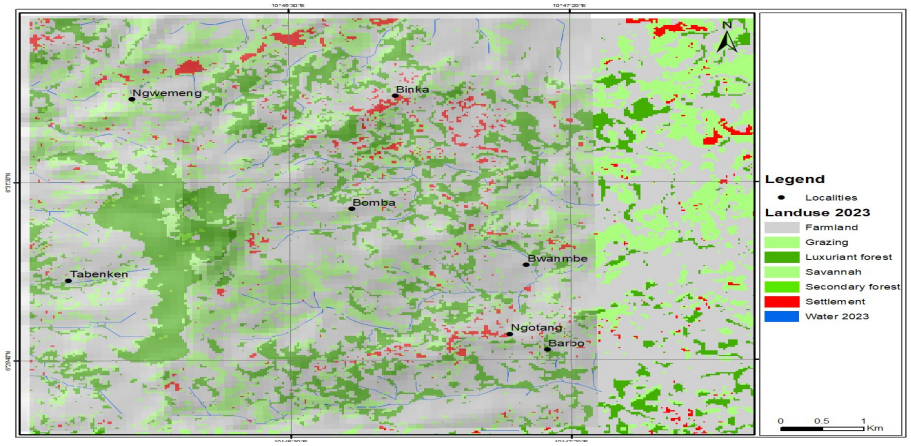

Figure 7. *Land cover change in Kup-Njiseng watershed and environs, 2023 Source: Landsat 8 image, 2023 LM08 and fieldwork,2023*

Analysis of the statistical land cover/use situation of the four periods (1993, 2003, 2013 and 2023) for the study area reveals significant mutations observed in terms of absolute and proportional changes to the area coverage of each of the land cover/use patterns (Figure 8).

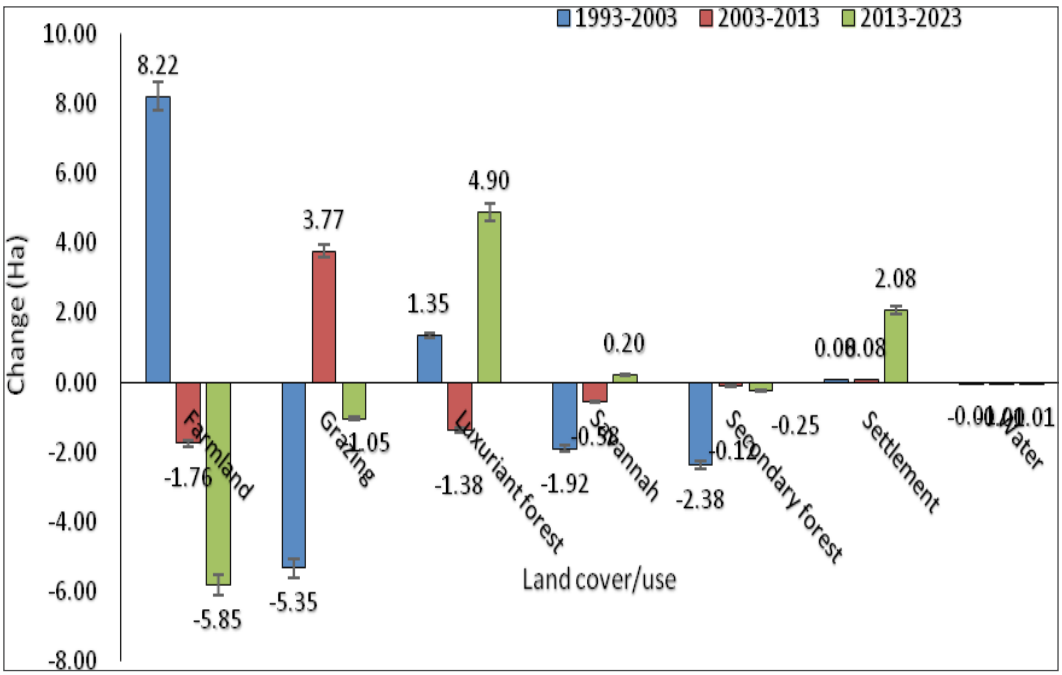

Figure 8. *Land cover change in Kup-Njiseng watershed and environs, 1993-2023 Source: Landsat image, 2023*

3.5 Constraints and Effects of Water Scarcity on the Population

Water scarcity predisposes the population to deleterious effects. These constraints range from long distance trekking in search of the precious resource reduced domestic use to minimize the quantity used, waste of valuable time and the difficulties transforming the poor water quality consumable. These constraints in general are at the genesis of numerous consequences such as conflicts between users, instigating the population to sort out alternative water sources and competition between users over the resource, thus, rendering the quality of life poor or making them vulnerable to water resources (Table 8).

Table 8. *Respondents' views on the constraints and effects of water scarcity on the population*

Options/ Neighbourhoods	Constraints of water scarcity				Effects of water scarcity			
	Long distance trekking	Poor water quality	Reduced domestic use	Valuable time wasted	Poorlife quality	Conflict	Alternative water sources	Competition between users
Bomba	8	20	9	7	21	8	9	6
Ngwemeng	6	8	3	4	6	7	4	4
Ngotang	6	4	2	3	4	6	3	3
Total	20	32	14	14	31	21	15	13
%	25	40	17.5	17.5	38.75	26.25	18.75	16.25

It will be unfair to deny the fact that people trek long distances in search of water especially during the dry season. This statement is confirmed by a 25% score where far away springs and streams are visited for water harvesting. Those mostly involved are females and children who spend precious time in trekking long distances (17.5%) rather than spending the precious time in valuable exercises. Most often, the water harvested are not pure as a result of pollution (40%) which emanates from human activities such as clothes and dishes washing especially by children who also fetch the water (Plate 2). It was obtained from the field that the washing of clothes and dishes around springs and streams is to reduce the quantity of water used in households coupled with the fact that the distances to these areas are pretty long.

Plate 2. *Water pollution leading to poor water quality. Photo 4 shows laundry closer to a spring, photo 5 shows a scrambling population waiting to fetch water according to arrival from a locally harnessed spring and photo 6 shows polluted water source yet ready to be harvested by children.* ***Source:*** *The Voice of Binka and Fieldwork, 2023*

Water from these sources can never improve quality of life as it can only be a source of vectors of water-borne diseases such as dysentery, cholera, typhoid fever and diarrhea. This is confirmed by 38.75% of the population attesting to the fact that the scramble for water at the sources leads to conflicts (26.25%) which further results into more water pollution. It was obtained from the field that clashes also emanate between the water managers and the population as they are often accused of unbiased attitude towards water management. This usually leads to competition among users (16.25%). While others corrupt the managers for regular flows for their construction works, others are forced to direct it into their gardens for vegetable cultivation while a good proportion of the population suffers abject scarcity. This has been the leading force for the search for alternative strategies of water in recent times. A majority of the population is now clamoring for private stand taps than public ones and is ready to pay any amount levied on them. This gives the notion of capability to managers who believe that those with private stand taps are capable of paying some stipends for regular flow in their houses.

3.6 Local Stakeholders' Role in Water Management in Kup-Njiseng and Environs

Water management on the Kup-Njiseng watershed and environs involves a number of stakeholders which include the elites, the local population and the traditional authorities each in its capacity to ensure the availability of water to the population (Table 9).

Table 9. *Stakeholders' role in water management*

Water committee/water technicians	Frequent checks on the harnessed catchments	Take decisions on matters concerning the sustainable management of water and propose extension	Report any challenges encountered in relation to water management	Ensures the safety and regular flow of water, prevent and stop illicit water distribution in the village
Elites	Lobby donors for funds and invite experts on water issues for sustainable management	Solicit the services of state technicians for technical works and training of local technicians	Mobilize funds for sustainable water management	Encourage sustainable management of catchment areas
Local population	Community works in assisting technicians in issues of repairs and water extension	Initiate a generalized fund raising in the different village fora without restrictions to the amount donated	Sustainable water management sensitization and organize cleanup campaigns around stand taps	Create awareness on the situation of the water in the village
Traditional authorities/ council	Issue bans on unsustainable human activities around catchments	Instruct secret society's police (masquerades) to mobilize people for community works and sanction culprits	Oversee the tradi-cultural aspects of the watershed and catchments	Carryout cultural conservation rites in the watershed and around catchment areas

Water management strategies put in place by these different local stakeholders include agroforestry where water friendly trees are planted around the catchment areas and within the Kup-Njiseng forest to boost the water table and readily make water available throughout the year. This strategy by extension has led to the reforestation process especially in areas of wanton human activities around catchment areas. The elites have embarked on the re-demarcation of the buffer zones with restrictions on human activities around catchments. The recreation of a water committee to ensure the sustainable governance of water is finalized with roles well defined for members. All stakeholders are hands on deck to create awareness and sensitize the population on the importance of sustainable water management through rationing especially during the dry season and to free taps during the rainy in order to release water pressure and preserve pipes from breakage. Alternative sources of water such as bore holes and wells are sought to release pressure on the water catchments Funds are raised to replace obsolete water infrastructures while new catchments have been earmarked and the harness activities are yet to commence. It is believed that once all the aforementioned strategies are laid down, water pricing will be installed. Payments depend on the type of usage as those with private stand pipes have a monthly amount to pay as against those who use the public taps.

The SWOT analysis of the Kup-Njiseng Watershed and environs show vibrant strengths which are: many water catchment areas with water potentials and a strong community labour force and the ability to lobby for aid). The opportunities provided therein are the designed sustainable water management strategies and alternative water sources. The weaknesses include the poor participation in community works and discriminative water distribution methods while the threats are the unsustainable anthropogenic activities around the catchment areas (Table 10).

Table 10. *SWOT analysis of water scarcity on the Kup-Njiseng watershed*

Strengths - Many catchment areas with freshwater potentials -Strong community labour force and ability to lobby donors (technicians/ finances)	**Opportunities** -Design sustainable water management strategies -Harness new sources, protect already existing catchments and create alternative water sources
Weaknesses -Partial participation in community water task/ water source disruption and damage with no punishment -Conflicts over water distribution methods	**Threats** -Poor water management and illicit water distribution -Unsustainable anthropogenic activities around catchment areas

4. Discussion

The Kup-Njiseng Watershed is one of the hotspot areas of the Bamenda Highlands with similarities with the Kilum-Ijim mountain forest. The rich biodiversity in terms of rich catchments with fresh water, fertile soils for agriculture, and a variety of tree, animals and bird species have made it appealing to the population for various reasons. This assertion is similar to those of Wirmvem et al., (2020) who affirmed that the Bamenda Highlands have numerous springs. Water is life and a birthright to all humans but this precious liquid is becoming very scarce as the population keeps increasing and at same time, exerting pressure on the water sources and resources. Human water management affects ecosystems, which in turn affect the livelihoods of the people that depend on them (Bos and Bergkamp, 2020). The over exploitation of the water sources for other anthropogenic activities such as agriculture which is usually accompanied by forest degradation is among the main drivers of water scarcity. The Kup-Njiseng Watershed and environs have undergone a series and progressive degradation of its water resources and sources which has led to the exposure of the catchments to the vices of the environment. Different land uses affect water resources through the alteration of groundwater recharge and stream discharge in specific areas and catchments (Shrivastava, 2019; Ndikebeng et al., 2023). The removal of the vegetation by the use of fire and farming in the catchment areas are unsustainable practices that have resulted to water scarcity. These have shunned the ability and the capacity of the watershed to extend water supplies to neighbouring villages such as Binshua and Bih that are not blessed to the same extent with the precious gift of live.

As we approach the next century, it is widely recognized that many countries are entering an era of severe water shortage. The gradual and steady encroachment of the population into the Kup-Njiseng watershed for more cultivable fertile land for crop production (maize, beans, solanum potatoes) has destroyed some prominent and important tree species

which acted as water catchment protection by shading the areas from the scourging effects of the sun. To acquire more food produce for their households and feed for their animals and to bolster their livelihood, the fertile soils around the catchment areas are exploited, though, unsustainably. This notion is in line with those of (Caceres et al., 2013) acknowledging the fact that areas for new fields are sought adjacent to or in and around the remaining forest patches with water available and where the soil is still very much fertile for the intended activities. Water scarcity leads to declining water quality and pollution, which has an especially adverse impact on the poor. Many (perhaps most) of the poorest people in developing countries are forced to drink water that is unfit for human consumption. They suffer from a range of skinrelated and other health problems (Barker et al., 2000).

The population is overusing water resources and over exploiting its sources, thus, transforming the already fragile water basin into agricultural and grazing lands. This is in line with Bos and Bergkamp, (2020) who affirmed that half of the world's wetlands have already been lost due to over abstraction of water and conversion into agricultural land. In most local management schemes, managers often implement rules to suit their personal interest and portray their personality. The severe scarcity in water ravaging the study area of recent is a germ of illicit and biased water distribution rooted in the poor water management attitude perpetrated by the managers. Dalezios et al., (2018) had opined that the current problem of water scarcity consists of the adverse result of ineffective water resources management and policies, as well as the availability of water in an area.

The local population together with the elites has put in place sustainable management strategies based partly on the ecosystem and people-based approaches to ensure safe and clean water throughout the year. Even though the ecosystem approach appears to emphasize hydrological and ecosystem processes, the real focus is on human processes. The different human uses and behaviors in a basin are interlinked; the actions of one can have an impact on another (Bos and Bergkamp, 2020). The combined effects of increasing population and anthropogenic activities towards and within the Kup-Njiseng and environs have strained the capacity of the forest and watershed to sustain the needs of this same growing population. The continuous growth of both human and animal populations and their continuous exploitation of water resources and water sources exert greater demands on the already degraded resources. This practice is in line with the notion of the tragedy of the commons of Garrett Hardin (1968). But technological interventions could serve as a stitch in time to catch up with increasing demand from the increasing population figures as notified by (Fonjong et al., 2005) in a study carried out in some selected rural communities in Cameroon.

5. Conclusion

Water is a valuable natural resource and Kup-Njiseng and environs are blessed with this precious gift which if well harnessed and efficiently managed, can support the entire population especially that of Binka village and even beyond. Albeit the continuous and tremendous mutations in land cover/use over the years reveal increase in settlement (population) as the main cause of water scarcity in the study area. Mutations in land cover/use are detrimental to water resources and potentials of the Kup-Njiseng and environs rooted in unsustainable anthropogenic activities with a negative bearing on the quality and quantity of water. However, stringent water policies, efficient water governance and the sustainable exploitation of resources around catchment areas could lead to water resilience and consequently, maximum recharge of the water table in the study area. The creation of awareness and the sensitization on the need to sustainably manage water are primordial for water quality and quantity availability all year round.

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