



## **Assessment of Drinking Water Catchments in Fako Division, South West Region, Cameroon**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors ME, KJ, NP and NAL conceived the study. Authors ME and RN designed the study. Authors KJ, NP and NAL supervised the study and provide major contributions in writing the manuscript. Author ME managed literature search and wrote the first manuscript while author RN analyzed the data and proofread the manuscript. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Background:** Without readily available water in sufficient quantity, and pathogen-free, man's progress is hindered. Globally, 2 billion people use sources of drinking water that are faecally contaminated and not appropriate for consumption. In Cameroon and specifically in fako division, due to acute piped drinking water shortage, the population uses alternative sources (springs and boreholes). Waterborne diseases are the second and third leading weekly epidemiological disease under surveillance in Fako. To find out some predisposing factors of waterborne diseases in Fako, and to meet up with Sustainable Development Goal (SDG): 6.1, by 2030, we sort to start with an assessment of the drinking water catchments in Fako, as we found paucity of studies.

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**Methods:** A community-based cross-sectional survey was conducted from January to May 2018 using quantitative and qualitative approaches. An adapted WHO checklist was used for observations around catchment, then a risk assessment was done with a semi quantitative approach. Qualitative data was collected through Focus Group Discussions and In-depth interviews.

**Results:** Of the 15 water catchments assessed, none of them met all WHO recommendations. We found that 60% have anthropogenic activities at less than 100meters from the catchments with progressive reduction in water volume and risk of contamination. Meanwhile 20% were open springs and consumers fetch water with feet and container deepen in source, while 13.3% were surface water. There was no integrated catchment management with stakeholders in Fako Division.

**Conclusion:** None of the catchments met WHO recommendations. An integrated drinking water management team and a periodic monitoring of these catchments is imperative.

*Keywords: Assessment; drinking water catchments; Fako division; Cameroon; drinking water quality.*

## 1. INTRODUCTION

It is a certainty that without water there would be no life of any kind on earth, and without readily available water in sufficient quantity, and free of disease-causing agents, man's progress is hindered. Globally, 2 billion people use sources of drinking water that are faecally contaminated and not appropriate for consumption [1]. The quality of drinking water is a major concern in low resource settings like Cameroon where water-borne diseases happen to be a yearly epidemic [2,3]. Waterborne diseases are the second and third leading reported weekly epidemiological disease under surveillance in Fako division, South West Region of Cameroon [4]. Water quality assessment is important for guiding water safety management and preventing water-borne diseases. With limited resources to manage drinking water at community level, effective source (catchment) protection can mitigate significant cost in water treatment, disinfection and improvement on quality [5].

Within the context in Cameroon, access to water through taps is a luxury which only a few (32%) inhabitants can afford. With the population growth and the urban sprawling, connecting running water throughout the city requires expanding the water supply network, which is often very challenging for the city councils and the government [6]. These often lead to frequent piped drinking water supply interruptions by the lone water supply body better known by the acronym 'CAMWATER'. The populations salvage their need for drinking water from the natural springs and few bore holes and other alternative water sources in their communities.

The term catchment area is used to describe the area immediately upstream from a source or well

[7]. When talking of catchment protection of water sources, usually this implies protective measures in a restricted area of one to several hectares surrounding the well or water source. Human activities in the area upstream from a spring or water source may affect the quantity and quality of the water that is obtained. This has a negative impact on the water buffering capacity of the catchment, leading to water shortage in the dry season. Run off from soil will also affect the water quality negatively. Farming in the direct vicinity of the source may also lead to contamination of the source with silt, nutrients and agro chemicals used in farming. Human activities like washing in the stream or construction of latrines upstream of a water intake point or source may also affect water quality. These effects are most evident in the direct vicinity of the source but human activities at a larger distance upstream from the dam or source may also affect water quantity and water quality in the long term [7]. These catchments need to be fenced, and should have no form of anthropogenic activities within 100 meters around it [8]. Unfenced drinking water catchments and nearby anthropogenic activities predisposes the water supply to contamination which could lead to (water-borne) illness, endocrine disruption, cancer, liver and kidney problems [8]. Unfortunately, this is the water that is still consumed in certain places justifying Sustainable Development Goal (SDG) 6 that seeks to scale up those using safely managed drinking water.

Catchment risk assessment is a survey of the catchment area. Raw water from a drinking-water supply is obtained for the possible identification of potential contaminants, so as to build an effective plan catchment management strategy [9]. An integrated management team with a

Water Safety Plan (WSP) in place can employ a comprehensive risk assessment and risk management approach that encompasses all steps in a drinking-water supply chain, from catchment to consumer [1]. Continuous public health surveillance is therefore necessary to detect waterborne disease and monitor health trends associated with drinking water exposure [10].

The SDG6.1 seeks to scale up the population using safely and basic managed drinking water by 2030. To achieve these, we employed the WSP model, that seeks to do assessment from catchment to point of use where we found paucity of studies in Fako. Our study therefore assessed drinking water catchments through observations, semi quantitative and qualitative approaches.

## 2. MATERIALS AND METHODS

### 2.1 Study Design

A community based cross-sectional study design involving both quantitative and qualitative (Focus Group Discussions and In-Depth Interviews) approaches were employed. We randomly selected 15 out of 26 drinking water catchments sources in Fako. We observed the catchment areas and then health held focus groups discussions (FGDs) and In-depth Interviews with the water management committee members.

### 2.2 Study Setting and Procedure

The study was carried out in Fako division located at the foot of Mount Fako, in the South – West Region of Cameroon during the months of January to May 2018. This Division has four Health Districts which are Buea, Limbe, Muyuka and Tiko.

We used probability proportionate to the size of the number of catchments to determine the number of water catchments to be used in each health district. From the four health district in Fako, we randomly selected nine catchments in Buea, and two each in Limbe, Muyuka and Tiko health districts giving a total of 15 water catchments as follows; Buea Health District: Bwitingi, Ameng, Woteke, Bolikawo, Upperfarms, Bore hole (Solidarity), Ewange, Wovila, Borehole mile 18, Limbe Health District: mile 2 and ewongo, Tiko Health District: ndongo and mile 14(Ikande) and Muyuka Health District: Moli and mile 29.

Two FGDs were conducted with consideration of homogeneity with respect to the management of drinking water sources in their various communities in Fako Division. We enrolled eight members of community water managers per FGD from the four health districts in Fako division. Ten In-depth interviews were conducted with personnel of stake holders of sanitation departments of water and energy, local council, public health, environment and housing and town planning of Fako division and at Regional levels.

### 2.3 Data Collection

Data were collected by using a check list with the following variables that were observed on each drinking water catchment; location of drinking water catchment, type of drinking water source, distance of drinking water source from houses, septic tanks and from farms. Characteristics of the physical environment round the water source; completeness of coverage by cement or roof, presence of stagnant water around source, whether or not people get in with their feet before fetching the water, trees planted around water source. We then used these results to conduct a risk assessment using an adapted semi-quantitative approach with the following variables (process step catchments, hazardous event, hazard type, the likelihood of occurrence, basis (risk characterization) and possible control measures (mitigation).

We used a FGD and an IDI guides for qualitative data. We conducted two FGDs with each lasting 90 minutes. Group 1 was conducted in mile 4 community hall Limbe among members of drinking water management committees of Tiko and Limbe health districts and group 2 at the conference room of the Buea Regional Hospital among members of drinking water management committees from Buea and Muyuka health district. During the FGD with members of community drinking water catchments committee, they were probed on awareness of the hazards around the drinking water catchments and their challenges in managing them. We also did an IDI with these members of community drinking water catchments committee and other stakeholders (probed on their relationship and functional activity or action plan with managing the drinking water catchments of their jurisdiction).

### 2.4 Data Analysis

Data obtained using checklist from observations around catchments was entered, cleaned and

prepared for tabulation using an adapted semi quantitative approach [11]. Data were categorized in two groups; quantitative for the risk assessment of the drinking water catchments and qualitative to have a detailed explanation of the results of the latter. We assessed the drinking water catchments in Fako to see if they met up with WHO recommendations, and fitting the results in an adapted semi quantitative approach to propose preventive measures.

### 3. RESULTS AND DISCUSSION

#### 3.1 Results

Of the 15 water catchments assessed in the study, none of them met WHO standards. Only one water catchment was fenced completely, and 3 had interrupted fences (Table 1). To this, some members of a community water management lamented; *“There is no functional policy or law protecting drinking water catchment, no direct responsible(s), not even the village chief of the community has a full authority around the drinking water catchment. Hence no mapping zones for drinking water catchments”* (Participant number 2 of group 1 FGD1).

*“Even the volume of water from the drinking water catchment is dropping gradually especially in the dry season, and if care is not taken, we might lose our catchment because of the activities going on around the catchments. In the days of the Germans or the days of our grandparents, there used to be, an overflow of water from the catchment”* (Participant number 1 of FGD1).

More than half (60%) of the drinking water catchments had farming activities less than 100 meters away (Table 1). Some community water managers said, *“farming is another serious problem. Individuals do carry out farming activities without respecting the 100 meters circumference demarcation from drinking water catchment”* (participant number 1 of FGD1).

*“When reprimanded by the village committee, they will present their land ownership certificate. In short there is no punitive law prohibiting farming <100 meter around drinking water catchments, not even from the ministry of agriculture”* Participant 3 of FGD2).

We also found out that, 20% (3 out of 15) are open springs of which in two of the catchments, consumers enter with feet to fetch drinking water. (Fig. 1, Table 1).

To this, what a member from water management committee said; *“community members have the notion that water is a free gift and expect not to contribute a dime for the building of a concrete covering the source and piping to their various homes, We are waiting for the government”* (participant number 4 of FGD2).

Another member from a different community said *“In our own community each household contribute a token annually which is used for managing piping and some local treatment once or twice a year. We have formed water users control committees who give us information on broken pipes for immediate repairs”* (participant number 6 of group FGD1).



**Fig. 1. Farming less than 30 m from catchment at mile 2, not concreted, not fenced and consumers dipped feet and containers in spring to fetch drinking water**  
(Source: Authors)

We observed that, 23.6% have houses with septic tanks <100 meters (Fig. 2).

To this, a participant had these to say; *“The community members need to be sensitized on the awareness on proper drinking water catchment management practices. How can people build houses less than 30 meters from a drinking water catchment? We have been having case sessions with community members on this, but to our greatest dismay, we were presented with a building permit from the council, land titles and site plans. I feel there is conflict between stakeholders of drinking water catchments, because the government has not put this a priority in their political agenda. We need to have regular meetings with all managing community drinking water, where we can discuss our problems, share experiences and plan a way forward”* (participant number 6 of FGD1).

*“We admit that we actually sign these building permits, but due do our very busy schedule, sometimes we sign without going on site, and sometimes we are persuaded to do so by the plot owners. It is a real problem which needs to be addressed with my collaborators of the technical bench”* Participant number 3 of in-depth interview (IDI).

*“we have no functional activity with other stakeholders, so it is a difficult situation to handle as a department alone. We need to work as a team, though I have often been reproached by some stakeholders”* Participant number 1 of IDI.

The results showed that, 13.3% of the water sources were surface water as seen in Fig. 3.



**Fig. 2. Ameng water catchment mile 16 with motorable road, open refuse dump, standing water, houses with septic tank all around less than 100 meters**  
(Source: Authors)



**Fig. 3. Showing Surface water source of Ndongo, Mutengene, farming around and not fenced**  
(Source: Authors)

**Table 1. Hazard assessment, risk management using adapted semi quantitative approach adapted from [1]**

S/N	Process step Catchments	Hazardous event (source of hazard)	Hazard type	likelihood	Basis (risk characterization)	Possible control measures (mitigation)
1	Upperfarms	Open catchment -No fence -Farming around	-Microbial	High risk	Water borne disease	Roof on catchment Fence catchment Stop farming <100m from catchment
2	Ewange	No trees  Enter with feet in water meant for drinking Open catchment No fence Farming around				Planting of water enhancing trees around catchment because the availability and especially the quality of water are strongly influenced by forests [12]. Health education to stop entering with feet in drinking source to fetch water
3	Woteke	No fence Slope	Microbial	High risk	Water borne disease	Fence catchment Reinforce water enhancing tree planting around catchment.
4	Ewongo	Farm <100 m No fence Standing water	Microbial Pesticide			Stop farming <100 meters from catchment Fence catchment Drain standing water around
5	Mile 2	Open Enter with feet in water meant for drinking				Roof on catchment Health education to stop entering with feet in drinking source to fetch water/pipping of water
6	Bolikawo(small soppo) camwatr	Surface water (stream) Farm <30 m Standing water				Stop farming <100m from catchment Drain standing water around.
7	Ndongo (Mutengene) CDC	No fence Open source				Fence catchment Roof on catchment
8	Ikande	No fence Standing water	Microbial	Medium risk	Water borne disease	Fence catchment Drain standing water around.
9	Kombe	Farm < 30 m				Stop farming <100m from catchment
10	Moli	Open source		High risk		Concrete catchment
11	Bwitingi	Interrupted fence Farm <30 m	Microbial Pesticide			Fence catchment Stop farming < 100m
12	Wotutu	House /Septic tank <100 m Open Interrupted fence Farm <30 m				Stop building houses <100m Appropriate regular treatment, monitoring and surveillance. Roof on catchment
13	Ameng	No fence Motorable road beside House/Septic tank<100 m Open refuse dump<100 m	Microbial			Deviate road away from catchment if possible but can be quite costly. However it can be cost effective to build high concrete fence around catchment. Stop open refuse dump around catchment. Appropriate regular treatment, monitoring and surveillance.
14	Solidarity (borehole),	House <100	Microbial	Moderate risk	Water borne disease,	Regular laboratory analysis of source water
15	Mile 18 (Borehole)	Farmland in the past	Chemicals from fertilizers		Cancer	

### 3.2 Discussion

The Sustainable Development Goal (SDG) 6.1, has as target to scale up the proportion of people using safely managed water. The SDG 6.1 could be achieved by implementing the model of the Water Safety Plan (WSP), which is based on the assessment and management of risk of water contamination at all stages of the water supply chain, from the point of capture (catchment) to the point of consumption.

Following the WHO checklist for drinking water catchments, we observed that none of the catchments met the standards. Only one out of the 15 water catchments in this study was fenced and 3 had interrupted fences. A total of 60% had farming activities <100 meters away from drinking water catchment, similar to studies carried in Buea, Ibadan and Lagos in Nigeria [13,14]. We also observed that in two of these open springs, consumers deep feet and container in source to fetch drinking water. We usually have burst, leaking and broken pipes that will last for days and weeks without due attention. All these adds to the burden of the consumers who have to pay exorbitant bills and pay for repairs. This often leads to household disconnection of water supply. As such, many households switch to public stand pipes and springs as alternative sources of drinking water supply is similar to a study in Kenya where community preferred to use alternative sources because of high connection fees [15].

The "right to water" as stated in the Cameroon water code of 1998 has been wrongly interpreted by the community as water is free of charge. The contribution must be moderate and not exorbitant [16]. Members of the community or rural areas need communication for behavior change on this notion that water is "free" or that the government must solely bare the cost of drinking water supply. Some communities do not treat their drinking water because members of the community don't contribute financially to purchase treatment reagents, "we simply wash the tank twice a year" "members refuse to pay the sum of 200 francs cfa annual levy per household for drinking water management". Others simply wash the tank every three or two months. "We were told the drinking water source is very pure and not to treat it". May be this statement was made when the catchments were still safe from anthropogenic activities. Also from an IDI we were told it's because they did not master the right use of chlorination. These

communities need to be sensitized of the dangers of anthropogenic effects found too close to these catchments that may jeopardize the quality of the natural spring. In addition, stakeholders need to carry out their duties to maintain the norms around these catchments as there apparently, exist no functional management body to cater for drinking water catchments in Fako [14]. It was acknowledged that building permits were signed without inspection of the apportioned pieces of land. Other stakeholders attested they were not aware they have as duty to be a part of an integrated team to manage drinking water catchments. We feel stringent policies need to be implemented to address drinking water catchment protection. Amongst the observed catchments, 13.3% were surface water, these stream sources are catchments serving the lone water utility company and parastatal corporation. The parastatal corporation uses a stream (Ndongo) while the lone water utility company catches an overflow of a spring source about 1km away migrating near farming areas. Though treated and piped, it is cost effective if hazards at sources can be mitigated or avoided. We observed that, 23.6% have houses with septic tanks less than 100 meters. There is no mapping zone for catchments. There should be a limit zone with anthropogenic activities around catchments [9]. From in-depth interviews with stakeholders, the members of the drinking water committees have no working document to reprimand perpetrators around drinking water catchments within their jurisdictions. Surprisingly, there still exist no integrated water committee 10 years ago after a recommendation to create one was addressed to the following stakeholders; the South-West governor, Regional delegate of ministry of water and energy, the mayor of Buea, chief of centre CAMWATER, SOWEDA AND RUMPI, from in a study done in Buea to assess source water protection in 2009 [14]. Though we have this law of water code revised in 2008, there is still inadequate political will to actually manage drinking water source protection. This law states council should oversee the management of potable water in their communities. This still needs to be fully implemented, for the water managers still complained of the council approving building permits very close to drinking water catchments. Councils need to visit and inspect all portions of land before actually signing building permits rather than approve of it in offices without going to the field. A participant in an IDI said 'I need to work as a team with my colleagues of the

technical bench, so we actually go to the field before signing building permits'. Groundwater is an important water resource for drinking water in Fako because of its rich natural spring catchments at the foot of Mount Fako. The populace of Fako, rely basically on natural springs for drinking water supply and even the population that uses pipe borne water, rely on these spring catchments. These is mostly observed during the peak of dry season between late January to March, when there is frequent and longer duration of interruption and rationing of drinking water supply by the lone national water utility body. The neglect of rural areas in most developing countries in terms of basic infrastructures such as pipe-borne water exposes the populace to a variety of health related problems such as water – borne diseases [11].

#### 4. CONCLUSION

Our results from the risk assessment showed that none of the drinking water catchments met WHO standards. Although 87% of the catchments were improved sources (springs), all of them were with hazards around (anthropogenic activities). There exists no integrated management body involving stakeholders for better management of these catchments to be able to improve on the drinking water quality from catchment and hence addressing one of the criteria to meet up with SDG 6.1 that seeks to scale up the proportion of people using safely managed water by 2030.

For sustainability of these drinking water catchments, we are recommending integrated strategies of the WSP model that bring stakeholders together to make available support tools that will help to achieve cost effective policies for management of drinking water quality from catchments. These can be achieved through periodic monitoring (system risk assessment), to minimize risk to drinking water supplies from catchments. Through this we will be able to improve on the drinking water quality from catchment and hence addressing one of the criteria to meet up with SDG 6.1 that seeks to scale up the proportion of people using safely managed water by 2030.

We also recommend a periodic monitoring of these catchments using the semi quantitative approach, and a physicochemical and microbial analysis should be done to qualify the sources as truly improved, as specified by the Joint Monitory Program (JMP) ladder for safely managed drinking.

#### CONSENT

Applicable consent form and the information sheet were duly integrated along with the respective data collection instruments. All the study participants were clearly informed about the objectives, procedures, risks and benefits, privacy and confidentiality issues of the study. Finally, written and informed consent was obtained from each study participant before interview.

#### ETHICAL APPROVAL

All authors hereby declare that the study have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. Ethical approval was granted by the University of Buea Faculty of Health Science Ethical Review Board (FSH IRB). Administrative authorization was gotten from the Regional Delegate of Public Health for the South West Region and from the various Chiefs and quarter heads whose villages harbours the water catchment areas.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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