

# **Water Resources Exploitation Practices and Challenges: The Case of River Meme, Cameroon**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors ASG and AZE conceived the study and developed the data collection instruments. Author AZE collected the data and wrote the first draft of the manuscript. Authors AZE, JNK and TES contributed in developing the manuscript. Author JNK reviewed the manuscript. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The exploitation of water resources, an aged old practice, continue to attract significant research and policy attention. For the most part, this subject has eluded geographical literature in the context of the River Meme. We contribute to provide empirical evidence, by exploring water resource exploitation practices, challenges and implications, taking the case of four exploitation sites in Mbonge. The study employed a random sample of 270 respondents drawn from four study communities, complemented by interviews. The data were analysed descriptively and inferentially, using the ANOVA. The results reveal that three resources were identified as key to include sand, fish and domestic water. The study further revealed that the exploitation of the resources of River Meme is important for socio-economic development, the provision of sand to construct local and modern structures, the creation of employment, and the provision of household income. Key exploitation challenges include inadequate capital, poor management approaches, the use of

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rudimentary tools, and conflict among others. The study concludes that, as a result of the challenges faced in the exploitation of water resources, River Meme should be developed as a recreational site – this will serve as a source of income generation to the local population.

*Keywords: Resources; exploitation; challenges; practices; Cameroon.*

## 1. INTRODUCTION

Of all the planet's renewable resources, water has a unique place. It is essential for sustaining all forms of life, food production, economic development, and for the general well-being of people. It is impossible to substitute water for most of its uses, difficult to de-pollute, expensive to transport, and it is truly a unique gift to mankind from nature. Water is also one of the most manageable of the natural resources as it is capable of diversion, transport, storage, and recycling. Water resource exploitation has been on the international spotlight for the past three decades. From the first International Conference on Water [1], followed by the first World Water Forum [2]. At the Second World Water Forum of 2000, the UN pledged to conduct periodic assessments on the state of the world's freshwater resources in the form of the World Water Development Report (WWDR), with which FAO is associated closely [3].

The demand for water resources like sand is growing around the world, particularly in the developing countries such as India, China, and Kenya, where rapid economic development causes strong growth of the construction industry. The global sand harvesting concerns about environmental impacts is increasing, according to reports from other countries such as China [4], Ghana [5] and India [6]. Consequently, it has been argued that because of this globalizing extent and the magnitude of its impacts, sand harvesting should be considered as an aspect of global environmental change [7]. Most countries in Sub-Saharan Africa continue to develop and benefit from the use of natural resources such as sand and gravel for economic development. [8] indicated that Nigerians also benefit a lot from sand and gravel mining which results in the construction of permanent structures from aggregates. This has improved the socio economic life of rural people. In Kenya, soil mining led to the development of better infrastructure [9]. This was supported by [10] who noted that as a positive impact of sand mining in Botswana, more land had been used to develop infrastructure in the form of shopping

malls and residential areas. Zimbabwe is not an exception to benefit from sand and gravel through infrastructural development [11]. Some of these materials are obtained along river courses. Water resource exploitation refers to the extraction of water for human consumption. This shows a connection with agricultural, industrial, recreation, transport and tourism development [3]. Operationally, water resource exploitation as used in this research refers to the extraction of sand, fish, and domestic water use from the River Meme in Cameroon.

Cameroon is blessed with abundant water resources but rapid population increase, unplanned urbanisation, growing industrial and socio-economic development have led to the poor and unsustainable management of these resources [12]. One of these resource sites is the River Meme which is replete with sand, fisheries and other resources. So far, knowledge gaps exist with regards to the exploitation practices, their implications and challenges in the context of the River Meme. There is therefore a need to examine how these resources are exploited, the impacts of the exploitation of these resources on the socio-economic lives of the exploiters, the challenges faced and the management options put forward.

### 1.1 Problem Statement

Freshwater species and habitats provide a wealth of goods and services to humanity. Nearly a billion people worldwide rely on fishes as their primary source of protein [13]. The United Nations Development Programme (UNDP's) Sustainable Development Goal (SDG) 6 focus on water. SDG 6 talks about the need to ensure the availability and sustainable management of water and sanitation for everyone on earth. Water scarcity affects more than 40% of people around the world, and that number is projected to go even higher as a result of climate change. If present trends continue, by 2050, at least one in four people are likely to be affected by recurring water shortages [14]. Mbonge Subdivision is blessed with different sources of water like, streams, boreholes, and rain water. This study is

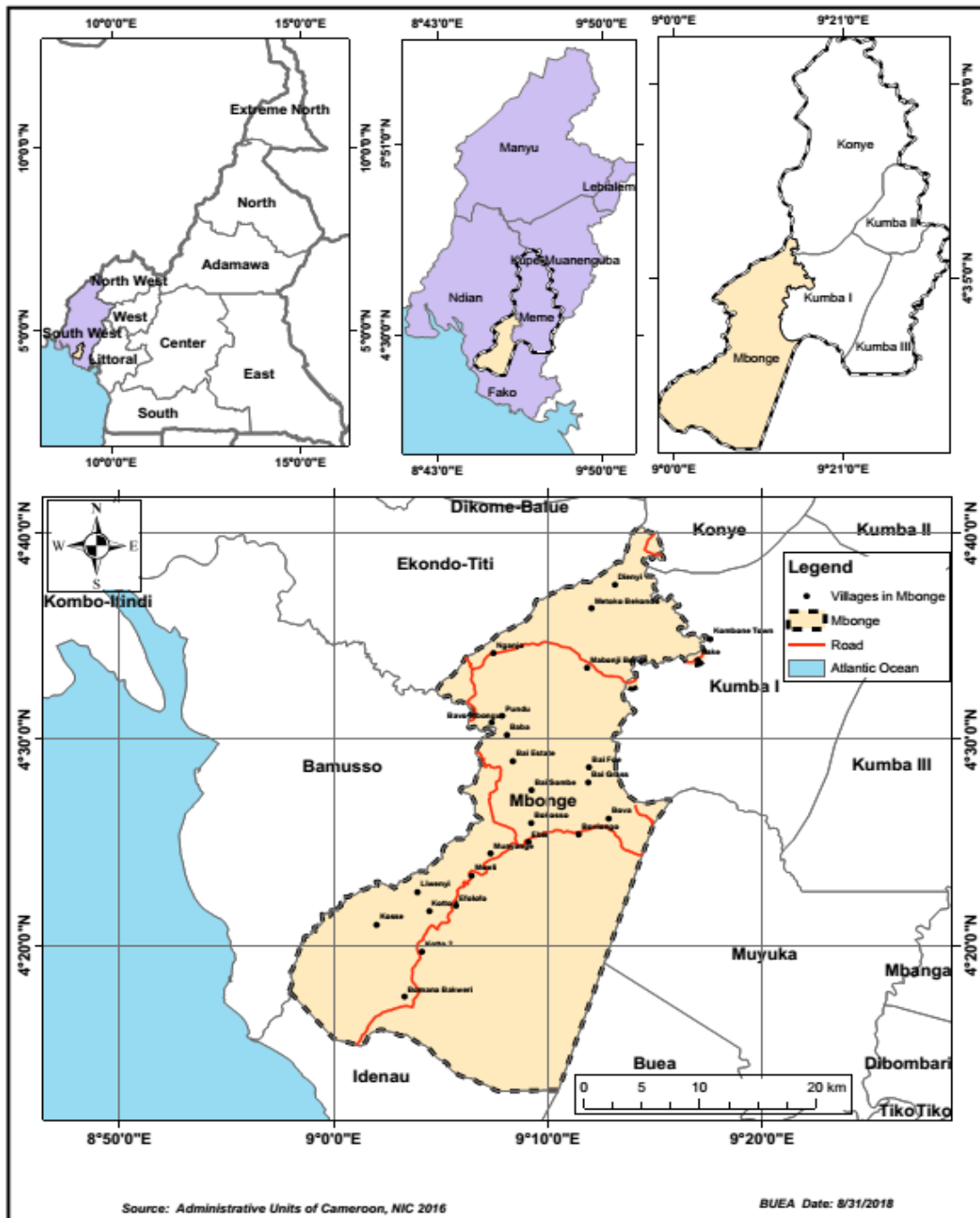


Fig. 1. Location of Mbonge Subdivision

Table 1. Distribution of 4 villages, their total population and homes of Mbonge subdivision

Number	Village	Population	Male	Female	Household
1	MbongeMarumba	6128	3069	3059	1586
2	Ngongo	2178	1093	1121	526
3	Bole Bakundu	4356	2154	2202	922
4	Bai Kuke	1648	906	742	365
Total		14310	7222	7124	3399

Source: NIS, 2005

based on Exploitable Water Resources (EWR). It focuses on River Meme being the highest producer of resources like fish, sand, and water for domestic uses and provides other environmental functions. It is worth noting that, River Meme is the main source of transportation of goods and services from one village to another, and from Mbonge to Nigeria. Therefore, the exploitation of this resource is a point of interest. So, assessing the importance of it will be of great assistance in solving the challenges so as to better manage the water for the sustainable development of Mbonge. Previous research efforts in the context of the study area have focused on climate, agriculture, transportation and water, around Meme. For example, Kimengsi and Tosam [15] examined the agricultural development policy implications of climate variability and cocoa production in Meme division of Cameroon. Mukete, et al. [16] analyzed the technical efficiency of smallholder cocoa farmers in Mbonge Municipality, Tosam and Njimanted [17] explored the socio-economic determinants of cocoa production in Meme Division, while Balgah and Kimengsi [18] investigated the sustainable management options linked to the declining water resources of the Lake Barombi Mbo. A fairly recent study by [19] focused on water quality assessment in Mbonge Marumba. These studies, however, did not focus on issues of water exploitation, their socio-economic implications, challenges and sustainable management strategies. This represents the motivation for the current research. Considering the fact that, these aspects have not received due research attention, this research seeks to examine the exploitation of the resources of River Meme. This is necessary against the back drop of increasing population, competing uses and increasing dependence on their resources. Studies of this nature have a global significance, especially when linked to the SDG 6. Meeting these targets require sound scientific knowledge at all scales.

## 1.2 Study Area

Mbonge Municipality (Fig. 1) (4° 32' 11" N; 9° 6' 40" E) is located in Meme Division of South West Cameroon [20]. It is bounded to the North by Kumba 1 council, to the South by Bamusso council, to the West by Ekondo Titi council, and to the East by Muyuka and Idenau councils [20]. The main water courses in this area are Rivers such as the Meme which cuts across many of the villages interspersed with streams and

springs. River Meme takes its rise from the Rumpi Hill in Kumba and runs into the Atlantic Ocean, also linking with River Ndiang. The water volume of River Meme, springs and streams increases significantly during the rainy seasons. Another major water body in this area is the lake Disoni which flows out and joins the Ube River and then further to the Meme in another section. The area of study falls within the delimitation of River Meme in the four selected villages of Mbonge Subdivision such as Mbonge Marumba, Bole Bakundu, Ngongo and Bai Kuke. Water courses are used in many ways mainly for farming, fishing, home use (drinking, laundry), catchments and recreational activities like swimming. The water courses can be harnessed and used for large scale irrigation, transportation, hydro-energy, potable water and large scale fishing.

Unlike most regions in Cameroon, Mbonge has a typical equatorial climate with two major seasons which are the rainy and the dry seasons. Annual temperature stands at 25°C and annual rainfall at 2210 mm [21]. The Climate is hot and dry, meanwhile in the rainy season; the climate is cold and humid. The area has been experiencing drastic changes as rains have come earlier and the dry season has also experienced some unexpected rains. For instance, rainfall was experienced right up to December in 2010 instead of October as was the case in the past. The implication here is that, it has altered the flow of River Meme, springs and other water sources. The relief of the area is gentle while some areas are undulating. However, the topography in some areas is hilly with steep and gentle slope like in the cases of Marumba. The total population for the entire municipality is estimated at about 230,000 inhabitants. The main indigenous and migrant ethnic groups include Mbonge, Bakundu, Balue, Ngolo, Bamilike, Batibo, Kom and the Efiks and Ibos from neighbouring Nigeria. The study is based on the 4 villages of Mbonge Subdivision with the total population of 14,310 [22] (Table 1).

## 2. RESEARCH METHODS

The design for this investigation is based on a mixed methods approach. The survey combines both quantitative and qualitative methods. Qualitatively, information from respondents pertaining to water resource exploitation, the socio-economic implications, challenges faced and management strategies were obtained with

the use of open and closed ended interviews. Quantitatively, data on the water exploitation and socio-economic implications was obtained through the use of semi-structured questionnaires.

There are four exploitation sites chosen cutting across the upper, middle and lower segments of River Meme. There are two exploitation sites in the upper stream, one in the middle and lower segments, respectively. Within these exploitation sites, four villages were chosen based on the nearness to these four sites. The study population involved the exploiters who have been engaged in the exploitation of the resources of River Meme from the four sites for at least five years. The communities include: Mbonge Marumba found in the lower stream, Bole Bakundu and Ngongo found in the middle stream and Bai-Kuke in the lower stream. There are about 500 exploiters in these localities (Sand Committee, 2017). The number of exploiters in the different localities are as follows Mbonge Marumba (238), Bole Bakundu (136), Ngongo (86) and Bai-Kuke (60). Therefore, the total population here for research is 520. This however, served as the base in which a sample of the target population had been drawn. The target population are the 520 exploiters from the four exploitation sites chosen from upper, middle and lower stream. Within these exploitation sites, four villages were chosen based on the nearness to these four sites. Hence, the target population is 520 exploiters. 270 questionnaires were administered randomly in the four study sites (Table 2).

Data obtained were analyzed using descriptive statistical tools (tables, charts, percentages, and figures) and inferential statistical tools (ANOVA). The ANOVA calculated value was compared with the critical or table value to validate the results with a degree of freedom of one and a level of significance of 0.05.

### 3. RESULTS AND DISCUSSION

#### 3.1 Nature of Exploitation of Resources of River Meme

River Meme is the main source of transportation of goods and services from one village to another and from Mbonge to Nigeria. Therefore, the exploitation of this resource is a point of interest. There are four exploitation sites (Fig. 2). Two sites in the upper stream, one site in the middle and one on the Lower stream respectively. Villages closer to the exploitation sites are Mbonge Marumba, Bole Bakundu, Ngongo and Bai kuke. These sites provide resources for sand exploitation, domestic use and local fishing.

Water used in households of the four villages were gotten from myriad sources (Table 3). Well was ranked as the 1<sup>st</sup> source as 232 respondents accepted that they obtain water for domestic activities from the River Meme, indicating that it is not used for drinking, rather for other domestic uses. Also, it is seen that, the highest frequency (104) of the uses of River Meme at home came from Mbonge Marumba and the lowest came from Bai Kuke with 21 respondents.

#### 3.2 Method and Tools Used in the Exploitation of Resources

Various methods are used in the exploitation of water resources. This ranges from local to modern methods. There must be the use of man's labor in the process of exploitation. From the fieldwork, direct observation and photographs taken,

it was seen that the exploitation of water, sand and fish in River Meme were done locally in the four exploitation sites. The different tools and methods used in the exploitation of the resources

**Table 2. Sample of the study sites**

Village	Number of exploiters	No of questionnaires	No retrieved	Percentage
MbongeMarumba	238	124	124	46
Bole Bakundu	136	71	71	26
Ngongo	86	44	40	15
Bai Kuke	60	31	25	9
Total	520	270	260	96%

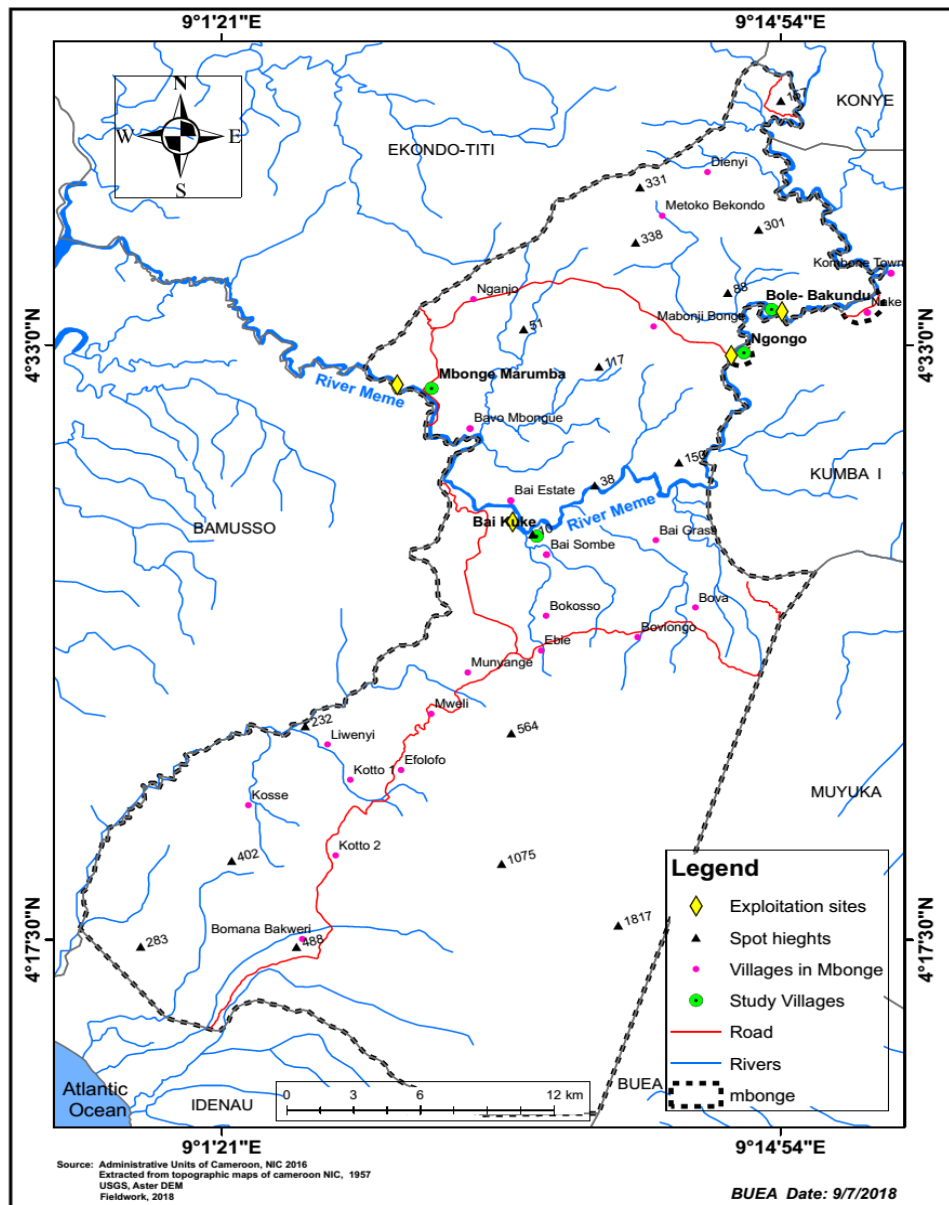


Fig. 2. Exploitation sites

Table 3. Sources of water in households in Mbonge Riverside localities

Locality	Sources of water for households									Spring	
	River			Tap			Well			Yes	No
	Yes	No	NR	Yes	No	NR	Yes	No	NR		
MbongeMarumba	104	20		81	43		98	26		25	99
Bole Bakundu	48	18	5	31	35	5	66	5	5	43	23
Ngongo	33	7		27	6	7	34	6		27	13
Bai Kuke	21	4		11	14		25			14	11
Total	206	49	5	150	108	12	223	32	5	109	146
Ranks	2 <sup>nd</sup>			3 <sup>rd</sup>			1 <sup>st</sup>			4 <sup>th</sup>	

were the same in all the four sites. The tools of sand exploitation are Buckets, Containers, Canoes, Head pans, piece of cloth and Spades

as seen from plate 1. Stick boat and canoes are used when exploitation is done far from the shore. The methods of harvesting



sand is local since local tools are used. Hill and Kleyrnans [23] discussed various methods of mining sand and gravel. Dry pit mining is a method used when sand is extracted above the water table from a dry stream bed and exposed bars using conventional bulldozers, scrapers and loaders. While wet pit mining involves the extraction of sand and gravel from below the water table, stream channel or a

perennial river using hydraulic excavator or dragline. As seen, two methods exist which are the dry and wet pit mining. It was realised that, sand harvesting from River is seen as wet pit mining though it is done locally. The method begins with the exploiter holding the head pan (plate A), diving into the water (plate B), filling and lifting of the head pan of sand from beneath the water, (plate C), the carrying of the head pan



**Plate 1. Sand instruments and methods of exploitation in River Meme**

*A=exploiter standing with the head pan, B=diving, C=lifting of the head pan of sand, D and E=exploiter carrying head pan of sand in water, F and G=exploiter carrying head pan of sand on land, H=pouring of sand, I and J=mounds of sand, K=head pan and piece of cloth*

of sand on the head with a piece of cloth by the exploiter while still in the water (plate D and E). Later, the exploiter gets to the land while still carrying the head pan of sand (plate F and G), pouring of sand on the land to make a mound (plate H) and lastly, making mounds of sand by the exploiter after about 10 rounds of harvesting of sand (I and J). The most important instrument needed in sand harvesting here is the head pan and the piece of cloth to help carry the pan on the head as seen in (plate K). The sand exploiters either exploit sand with bare bodies or they wear nylon dresses which are light so that water cannot stick on them. It is worth noting that, sand harvesting is done for a day as many times as the exploiters want. It all depends on his strength. Some were found making 5-6 mounds per daily.

### 3.3 Reasons for Exploiting Water Resources

Exploitation is carried out for myriad of reasons. This could be as a result of the poor level of education, limited jobs, large family sizes, leisure and inadequate income. The highest number of responses was 180 exploiters who agreed that, water exploitation especially sand was done for the purpose to raise income in order to feed the large family size (Fig. 3). The exploitation of water, and fish from River Meme has brought development in the area (Table 4).

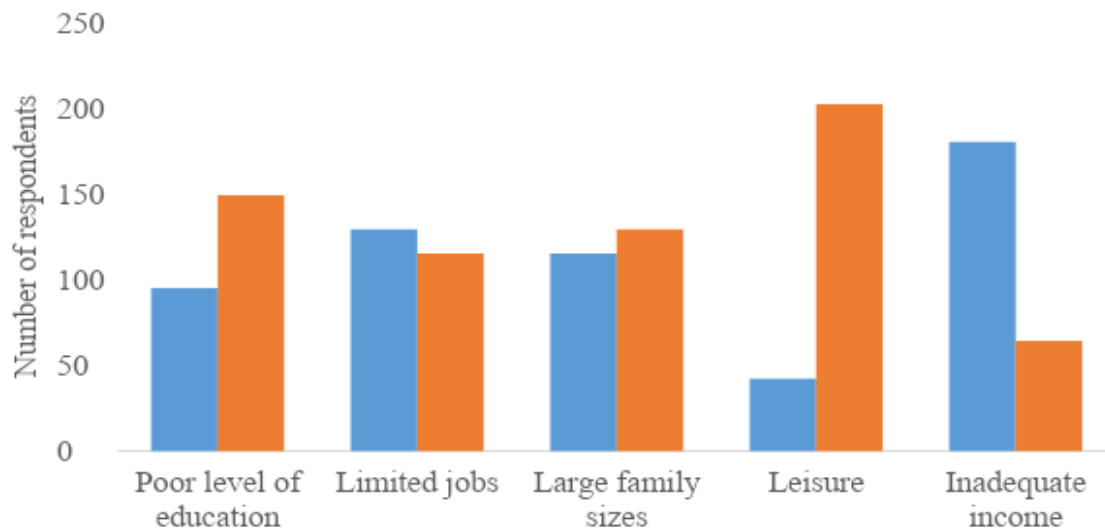


Fig. 3. Reasons for exploiting water resources

The F-Test was employed to test whether there is any significant difference in the mean responses of exploiters on the extent of socio-economic contribution of the activity within the Mbonge area. Here four main samples which represent the communities and their mean responses related to each hypothesised factor or socio-economic variable (Table 5).

With a degree of freedom of 3 and 20, the table F-value at a 0.05 level of significance is 3.10. Since the calculated F-value (1.4) is less than the critical F-value (3.10), it was observed that there is no significant difference in the extent of development within the four selected villages in Mbonge Subdivision as a result of exploitation of the resources of River Meme. Therefore, development is the same. As a contribution to household development, monthly income from this activity ranges from 50,000 frs to 150,000 frs (Fig. 4).

### 3.4 Challenges faced in the Exploitation of the Resources of River Meme

[24] holds that all the regions of the world show an overall net negative impact of climate change on water resources and freshwater ecosystems. The future effect of climate change on water resources in the world will depend on the trends in both climatic and non-climatic factors. There are climatic and non-climatic challenges affecting the exploitation of the resources of River Meme as seen from Table 6.

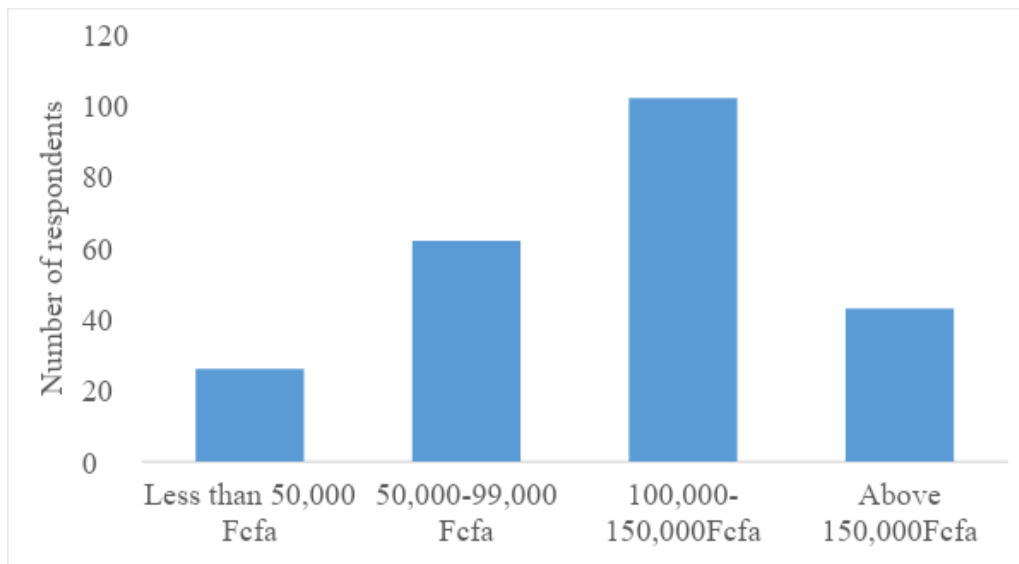


**Table 4. Assessment of the extent of socio-economic contribution of exploitation to communities**

Contribution of exploitation to community livelihood	Mean responses of exploiters at Mbonge Marumba	Mean responses of exploiters at Bole Bakundu	Mean responses of exploiters at Ngongo	Mean responses of exploiters at Bai Kuke
Alleviation of poverty	1.67	1.31	1.39	1.17
Increase Living standards	1.55	1.58	1.73	1.39
Provide self-employment	1.56	1.56	1.39	1.43
Increase Household sanitation	1.98	3.37	3.17	1.78
Aid in construction activities	1.6	3.04	1.24	1.52
Increase communication	1.66	2.92	1.9	2.52

**Table 5. F-Test results**

Source of variance	Sum of squares (b)	Degree of freedom(a)	Variance of estimate (b/c)	F
Between samples	1.68	3	0.56	= 0.56/0.40= 1.4
Within samples	7.93	20	0.40	



**Fig. 4. Estimated monthly Income from Exploitation of Sand and Fishing activities at River Meme**

Based on the Likert scale responses on the challenges (Four point Likert scale), a mean score of below 2 indicates a high tendency towards agreement and an indication that the factor is significant (is a challenge) while a mean score of more than 2 indicates a high tendency towards disagreement and an indication that the factor is not significant (it is not a challenge

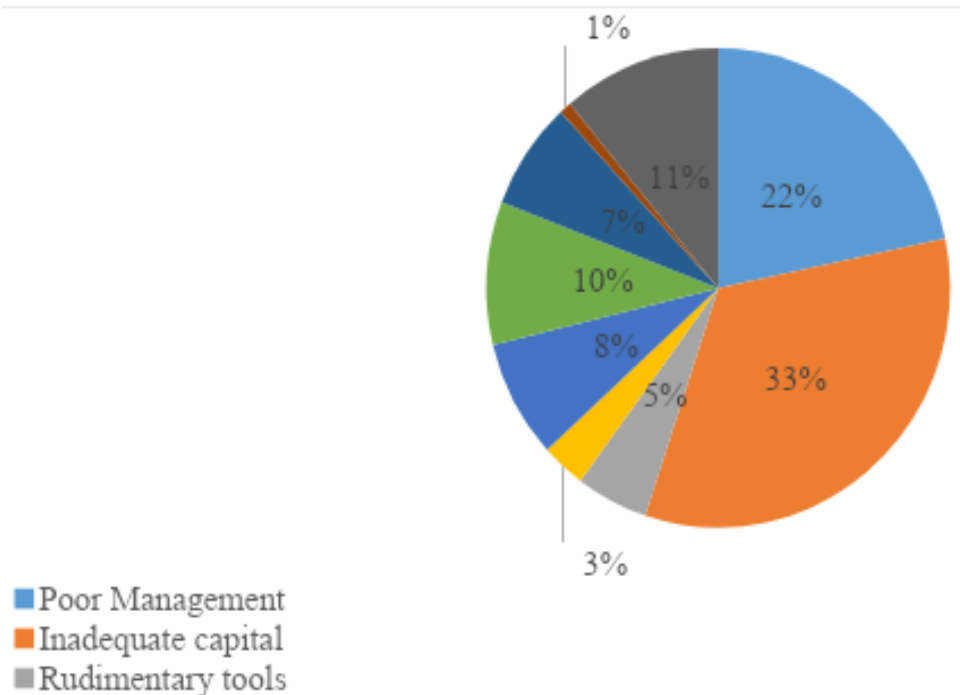
observed). Looking at Mbonge Marumba which is found in the lower stream of River Meme, challenges facing the exploitation of resources are inadequate capital, followed by poor management, rudimentary tools, fear of attacks and witchcraft. These are the perception of the people on the type of challenges they face in exploitation. Climate change with a mean of 2.3

can be seen as a challenge since it's not too far from the range of 2. With respect to the challenges faced in Bole Bakundu, inadequate capital, poor management, witchcraft, restriction from authorities, rudimentary tools and fear of the attacks of crocodiles and water tortoise and conflict were identified. Furthermore, the challenges faced in the exploitation of the resources of River Meme in Ngongo include inadequate capital, poor management, fear of attacks and increase

population, among others. The exploitation of the resources also faces challenges in Bai Kuke. They include inadequate capital, poor management, fear attacks and witchcraft. From the explanation given above, it is concluded that, the challenges facing water resource exploitation vary from one exploitation site to another (Fig. 5). The third challenge are the used rudimentary tools among others. From this, one can say that, the challenges faced are as a result of inadequate capital.

**Table 6. Challenges in the exploitation of resources of River Meme**

Challenges faced in the exploitation of sand in River Meme by communities	Mean responses of exploiters at Mbonge Marumba	Mean responses of exploiters at Bole Bakundu	Mean responses of exploiters at Ngongo	Mean responses of exploiters at Bai Kuke
Poor Management	1.38	1.4	1.3	1.4
Inadequate capital	1.09	1	1	1
Rudimentary tools	1.75	1.91	2.35	2.2
Climate change	2.03	2.13	2.13	2.48
Fear of attacks	1.72	1.93	1.65	1.76
Witchcraft	1.81	1.6	1.68	1.84
Restrictions from authorities	2.63	1.74	2	3.05
Conflict	2.26	2.09	2.35	2.32
Increase Population	2.23	2.39	1.65	3.4



**Fig. 5. Challenges in the exploitation of resources of River Meme**

#### 4. CONCLUSION AND RECOMMENDATIONS

Mbonge Subdivision is blessed with an exploitable water resource known as River Meme. 95% of the people exploit this River and 95% of the exploiters are adults. River Meme is the highest producer of resources like fish, sand, and water for domestic uses and serves other environmental functions in that area. It is worth knowing that, River Meme is the main source of transportation of goods and services from one village to another and from Mbonge to Nigeria. Mainly crude tools and methods are used to exploit sand, fish and water for domestic purposes. The exploitation of these resources raise income and improve on the livelihood of the people thereby bringing development. But some challenges are encountered in the exploitation of resources such as climate change leading to the reduction in the level of the River, inadequate capital, poor management, fear of attacks of water animals like crocodiles and water tortoise, among others. From the foregoing, the following recommendations are proposed:

- Policy makers and water managers like the Council, Custom Office and community leaders should be encouraged and motivated to take the necessary steps needed for resource exploitation for sustainability, to ensure that exploiters receive and take advice given seriously.
- There should be the creation of committees and projects like the River Meme Project (RMP) and the River Meme Exploitation and Management Committee (RMEMC). The RMEMC should be in charge of collecting money from the exploiters and individuals in the form of community fund raising so as to develop the River. Also, funds should be gotten from NGOs to carry out the RMP for the provision of potable water.
- The use of sand drilling machine is needed to drill the sand even once so that other uses of the River can be boosted. The research recommend that River Meme should be developed by the creation of recreational sites there. From field observations, it was realised that there were unfinished buildings of the German and Mbonge beaches around the River in Mbonge Marumba and the people still made use of it. If these beaches are fully developed, it will act as a source of income

generation which can help to provide capital to better manage the River.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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